SCIENCE

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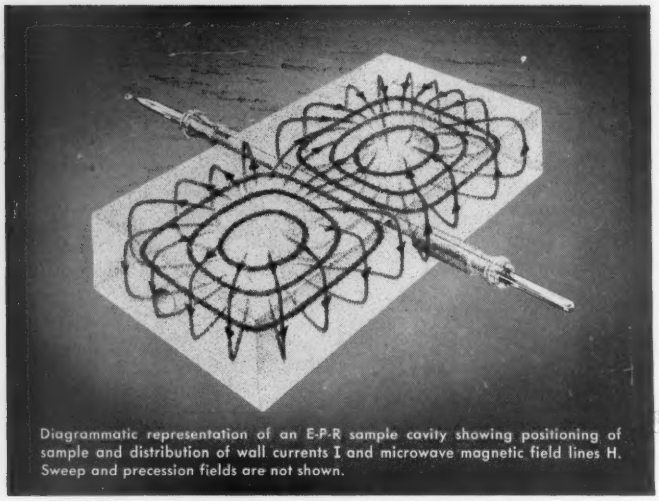

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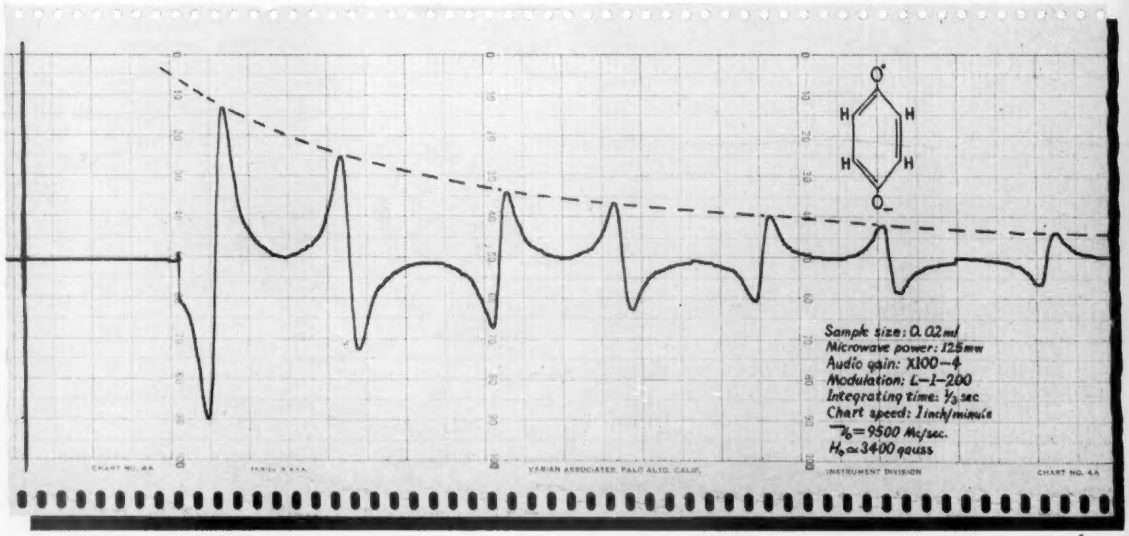

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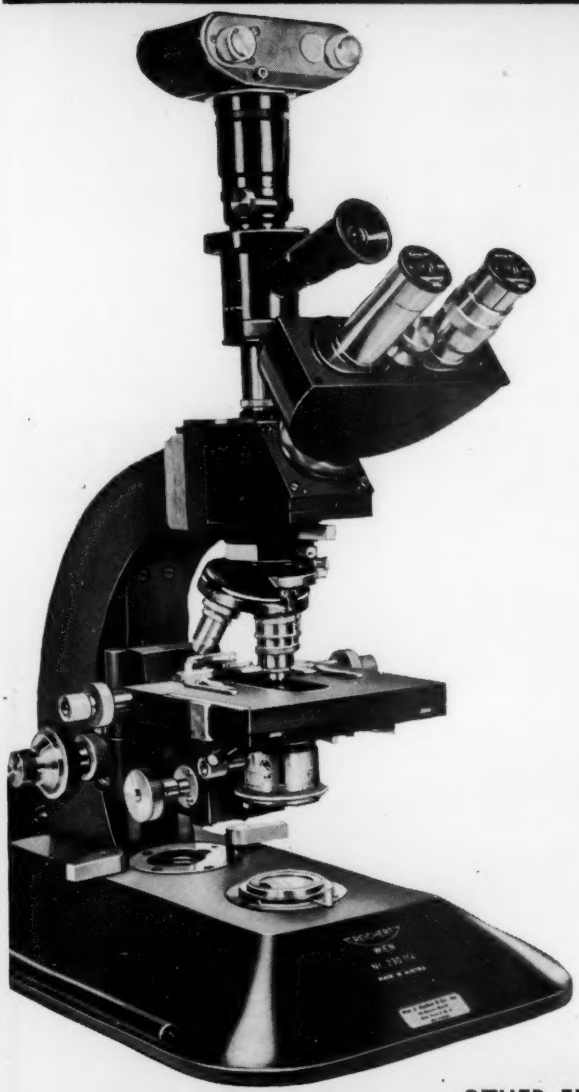

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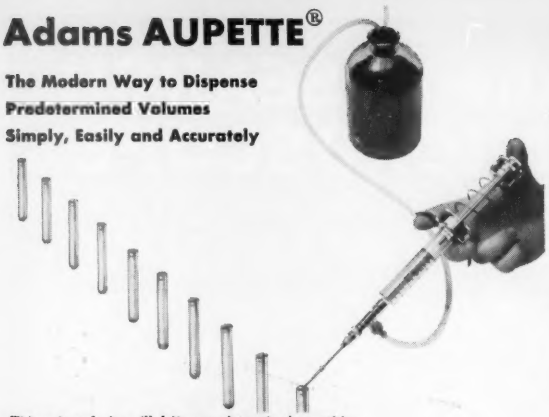

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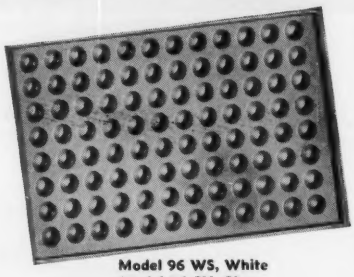

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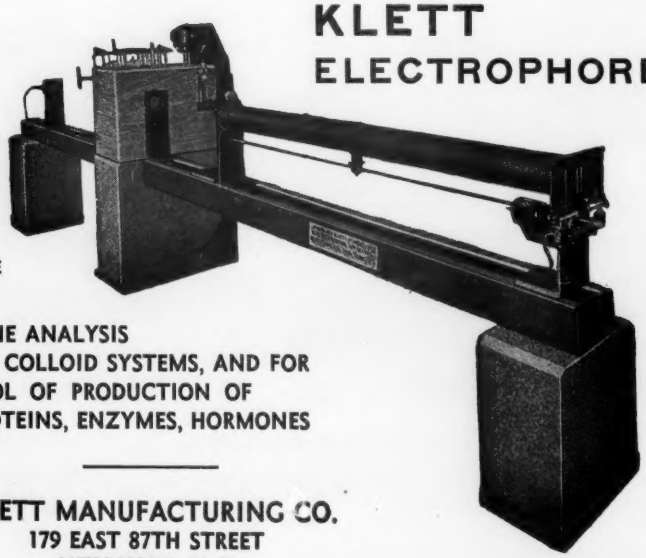

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VOLUME 1

PROBLEMS IN NUCLEAR ENGINEERING

During the planning for the International Congress on the Peaceful Uses of Atomic Energy, at Geneva in 1955, it was obvious that only a small number of the interested persons would be able to attend. The Engineers' Joint Council organized the Nuclear Engineering and Science Congress for the original purpose of "bringing the information presented at Geneva" to American scientists and engineers. This meeting was held in Cleveland, Ohio, December 12–16, 1955.

The Committees planning the Cleveland meeting, however, went further than the planners for the Geneva Conference in that more engineering-type papers were suggested, and these papers were to include not only the information presented at Geneva but were intended to include additional information which could be declassified but could not be presented at Geneva because of the limitation on time.

As a result, the Congress was held in Cleveland at which there were 358 technical papers presented—many of them wider in scope than those presented at Geneva. Most of the papers at the Cleveland Congress have been or will be published in the regular engineering journals. The Engineers' Joint Council and the various engineering publications have graciously granted permission to use their copyrighted articles, thus making this publication possible, in order that the most significant of the papers can be made available to those persons desiring the information in book form. The Pergamon Press has undertaken this publication as part of their general publications in the nuclear field. In addition, it is hoped to publish the papers to be presented to the Engineers' Joint Council Meeting on Fuel Cycles to be held in Philadelphia in March, 1957, as a part of this same series of books.

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The papers presented here are mainly original papers and cover engineering subjects. Most of the work was done in government laboratories or by industrial organizations under contracts with the Atomic Energy Commission. Many of the papers summarize the work carried out by several groups of people.

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Impossible Choices

The present problem of young people at college is much the same everywhere. They are finding their way into an enormous cognitive jungle, the jungle of everything there is to know. In recent years, I have talked with and been among undergraduates—and schoolboys and graduate students as well—in some places around the country, and a typical agony is: "What do I do? Where am I headed?" The complement of that, of course, is to be told what to do.

There is a spectrum between openness and permissiveness, on the one hand, and rather strict and specific guidance, on the other; between knowledge as an end in itself, something to study because of the joy of it and the beauty of it—and knowledge as an instrument, as a way of getting on in the future. Here, and in other institutions that lie on the instrumental, on the predetermined, side of the spectrum, I sense among the students a loss of the things which they are not studying; the sense of loss at all that they might be learning, and are not; the slight fear that this might not be easy to make up at a later time.

And yet this loss is a much larger thing, a quite general part of human life. There is much more that one might know than any of us are ever going to know. There is much more to know than any of us are ever going to catch up with; and this is not just the trivial fact that we don't work hard enough; it is not the trivial fact that things are difficult to learn. It is that any form of knowledge really precludes other forms; that any serious study of one thing cuts out some other part of your life. Narrowness is not an accident of one place, but it is a condition of knowledge.

I think myself that, with the growth of knowledge—the immense perplexity, the pervasive mutual relevance of different things to each other—all we can do is to accept the state of affairs, to affirm it, and to accept it deeply. It is not that some courses are not better than others and some worse, some even good and some evil; it is that, in the balance between ignorance and loss, on the one hand, and knowledge and richness of experience, on the other, we have to keep the affirmative love of the knowledge and the richness very close and never deny that most of what men can know, we don't know; that much of what man can know, nobody knows.

Of course, in a certain sense, this is trivial, and people have always known it. When it comes to the will, the element of choice has always been clear. The fact that you had one course which precluded another; you could take a job, or you could continue to study; you could marry, or you could say goodbye; everybody knows that. But I think it has not been quite as clear how, in the very conditions of knowledge, choice is built in and exclusion is part of depth.—J. ROBERT OPPENHEIMER, *Institute for Advanced Study, Princeton, New Jersey.*

This editorial is based on excerpts from an address given to the undergraduates at the California Institute of Technology and published in Engineering and Technology (*March 1957*).

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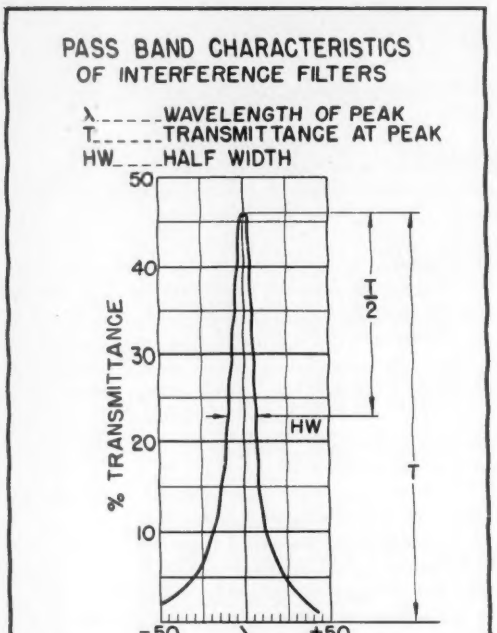

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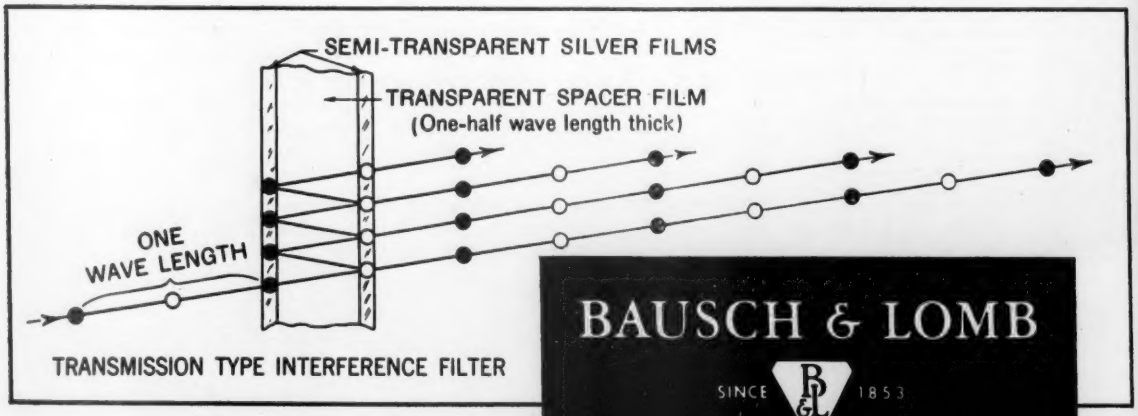

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Hepatic Sphincters

Brief Summary of Present-Day Knowledge

Melvin H. Knisely, Fann Harding, Hilda Debacker

Studies of normal and pathologic circulatory physiology sometimes are carried out without taking into account (i) the blood-cell-reservoir function of the spleen, and (ii) the blood-reservoir function of the liver and portal vein bed. For instance, some of the recent reviews of the factors which affect and limit cardiac output in health and disease have paid but scant attention to the accumulated knowledge of the structure and reservoir functioning of the spleen, portal vein bed, and liver (*1*). The purposes of this article (*2*) are to give adequate leads to the earlier fundamental literature and to present a brief summation of the recent and growing knowledge in this field. The references to the basic older literature are particularly important because they come from at least two specialized fields of study: anatomy and normal circulatory physiology. Specialists in other fields of biology, medicine, and surgery are often unaware of this basic literature.

A blood reservoir may be defined as a region of the vascular apparatus of variable capacity, in which controlled amounts of blood can be stored and from which controlled amounts can be released. A necessary part of a reservoir system is physical apparatus that is capable of controlling the outflow of blood from the reservoir. The stored blood is not necessarily in the reservoir because the tissues of the reservoir are acting upon it in any special way or because the stored blood is necessary for the use of the reservoir apparatus itself. The stored blood may sometimes be stationary or moving, or various amounts may be accepted by the reservoir while other amounts are being released. Ordinary arteries cannot be considered significant as blood reservoirs because of their low capacity.

Spleen

The spleens of mammals are sometimes said to "store blood." This statement is inaccurate and misleading. The spleens of mammals, including man, store and release highly concentrated blood cells. Yang (*3*) and Yang and Chang (*4*) found that *human* spleens can store and, upon adequate stimulus, eject concentrated blood cells. This storage-and-release acts to increase or decrease the circulating red cell count, and thereby acts toward maintaining the count constant. Obviously, this also affects circulating blood volume.

Robert M. Berne has prepared a 16-millimeter motion picture which records a large volume change in the spleen of the dog. The film not only presents concrete evidence for scientists but also is ideal for classroom presentation. It can be borrowed for study (*5*). (For the older, basic literature and summary of the evidence that the spleens of mammals store and release concentrated blood cells, rather than whole blood, see *6, 7.*)

Liver and Portal Vein Bed

There is a rather large literature dealing with the blood-reservoir functions of the liver and of portal vein bed, beginning with Stolnikow in 1882 (*8–13*). A detailed analysis and summary of the fundamental knowledge was given by Knisely, Bloch, and Warner in 1948 (*7*). Descriptions of a few critical experiments follow.

Johansson and Tigerstedt (*14*) found that when saline or defibrinated blood was transfused into rabbits, large quantities of blood were stored in the liver. They say (translated): "The second fact to which we would draw attention is the great distention of the liver which we have observed in all our transfusion experiments and which has also been noted by earlier workers. After the injection of large quantities of fluid the liver becomes almost as hard as a board. If after the death of the animal the liver is cut out, fluid streams from it in great quantities. We see that a considerable quantity of fluid is taken up by the liver and thus withdrawn from the general circulation."

Krogh and Lindhard (*15*) and Krogh (*16*) clearly demonstrated by experiments performed on young, healthy, normal, unanesthetized, untraumatized, unfrightened men—namely, themselves—that the human liver and portal vein bed can store large amounts of blood, and that the rate at which such stored blood is poured into the inferior vena cava is a mathematical determinant of the amount of blood delivered to the heart. This means that the control of the outflow of blood from the livers of healthy human beings is a major factor in the control of cardiac output. These experiments did not make it possible to locate the anatomical structures that control the outflow from the liver and portal vein bed.

Jarisch and Ludwig (*17*), working with rabbits and cats, demonstrated that the veins of the intestines (which are tributaries of the portal vein) are a blood reservoir. Following even small injections of saline or blood into the animal's jugular vein, the volume of the intestinal vessels rose promptly and sharply. The vessels of the animal's legs did not make this response. The ability of the intestinal vessels to store blood was immediately abolished in all cases in which the innervation of the liver was destroyed. It must therefore be concluded that the storing of blood in in-

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testinal vessels is dependent on blood-flow control mechanisms within the liver.

Grab, Janssen, and Rein (*18*) found in 44 experiments on dogs that it was possible, following the administration of different doses of adrenalin, to cause the liver to eject a volume of blood equivalent to as much as 59 percent of the weight of the emptied organ.

Storage Control Mechanisms

Bauer, Dale, Poulsson, and Richards (*19*) found that in dogs the contraction of the large hepatic veins is a mechanism which can initiate the storage of blood in the liver. They also found that in their preparations small doses of adrenalin caused the outflow control mechanisms to relax.

The hepatic outflow control mechanisms have received several names, such as *sluice valves, sluice channels, throttle veins* and, in German, *Drosselvenen.* These terms have developed in general as a result of experiments using the methods of gross physiology. For the most part, the terms designate function and not specific, identified portions of anatomy. For a summary of the older anatomical knowledge of *Drosselvenen,* see Benninghof (*9*), Franklin (*10*), and Arey *et al.* (*12*).

Within recent years, knowledge of the specific anatomical locations of the contractile outflow control mechanisms has been growing. Four, perhaps five, separate sets of mechanisms are now known which can control the outflow of blood from the portal vein bed and liver.

Contractile hepatic veins. In dogs, long stretches of whole hepatic veins can dilate widely or contract so tightly shut that the available blood pressure cannot force them open (*12, 13, 19, 20*). Arey *et al.* (*12*), using wax plate reconstruction methods, have provided precise descriptions of the arrangements of stainable smooth muscles in hepatic venules of various sizes in the dog, raccoon, and fur seal.

According to Testut and Latarjet (*21*) (translated): ". . . the hepatic veins differ from the portal vein branches by the quite special development of their muscular fibers, which form a real tunic around their whole circumference and over their whole extent. This muscular tunic . . . consists of an internal layer of circular fibers and an external layer of longitudinal fibers. It is rather thin in man but very thick in some animals: thus, it reaches a thickness of 4 mm. in the ox and in the horse."

Contractile sublobular veins. Deysach (*22*) presented pharmacologic and histologic evidences that the sublobular veins are powerfully contractile in the cat, rabbit, raccoon, Virginia opossum, grizzly bear, coati mundi, white-tailed deer, "and others." (Deysach received his rare animals from a zoo.)

Deysach "small sluice channel." A fairly large number of hepatic sinusoids come together into a single channel which enters either a central or sublobular venule through a single contractile sphincter, which is the "small sluice channel." Deysach (*22*) first described these channels and demonstrated their presence mainly in adult cats and rabbits. Harding (*23*) saw Deysach small sluice channels in the living livers of frogs, mice, rats, hamsters, guinea pigs, rabbits, cats, dogs, and rhesus monkeys. The small sluice channels are greatly outnumbered by the fourth type of outflow control mechanism.

Sinusoid outlet sphincters. Each hepatic sinusoid or small group of sinusoids drains through a single outlet sphincter into a central or small sublobular venule (see Fig. 1). When one sinusoid outlet sphincter remains open, and those on each side of it shut off tightly, the blood from several of the neighboring, branching, and anastomosing sinusoids passes out through the single open-outlet sphincter. It is often difficult or impossible to know whether a given Deysach small sluice channel definitely is an anatomical structure, or whether the arrangement observed is a result of the aforementioned physiologic activities of the tissues at the moment.

Possible fifth mechanism. The arrangement of the smooth muscle fibers of the wall of the vena cava, arching around the outlet orifices of the large hepatic veins may, in some species, be a hepatic outflow control mechanism (see, for instance, the suggestive figure presented by R. Spanner, *24*). Both Arey *et al.* (*12*) and Franklin (*10*) provide reviews of older, relevant anatomical knowledge, mainly concerning possible throttle-valve mechanisms in aquatic diving mammals.

Sphincters of the Liver Lobule

Knisely, Bloch, and Warner (*7*) presented a diagram showing the parts of the liver lobule of frogs, based on microscopic study of the quartz-rod transilluminated living livers of 3500 animals (for anatomical orientation, see Fig. 1). The purpose of their study was to learn the structure and visible mechanical functioning of the parts of the liver lobule of one species thoroughly; it would then be possible to see which structures and functions of the liver lobules of other species are like those of frogs, and which differ, and how they differ. These investigators also reported the presence of inlet and outlet sphincters, which were observed in the lobules of one rhesus monkey.

Since then, Seneviratne (*25*) has studied living frog, mouse, and rat livers and reported that he could not see sphincter valves in any of these species. However, his Figs. 7, 9, and 10 show sinusoids ending blindly, leaving a clear space between the ends of the sinusoids and the adjacent larger vessel. This is the exact appearance of rows of sphincters when they are contracted tightly shut.

Both inlet and outlet sphincters have been observed by Irwin and Macdonald (*26*) in living guinea pigs; by Bloch (*27*) in 6000 living animals (frogs, rats, mice, bats, guinea pigs, rabbits, and rhesus monkeys); by Rappaport (*28*) in living weanling white rats. Outlet sphincters were seen by Harding (*23*) in living frogs, mice, rats, hamsters, guinea pigs, rabbits, cats, dogs, and in one rhesus monkey. Inlet sphincters have been seen during the past 5 years in our laboratory in living frogs, mice, rats, cats, hamsters, and dogs.

In summation, both inlet and outlet sphincters have now been seen in the livers of living frogs, mice, rats, guinea pigs, rabbits, hamsters, bats, cats, dogs, and rhesus monkeys.

In quartz-rod transilluminated livers, the sphincters have been observed by using high-resolving Leitz biobjective binocular dissection microscopes, which give magnifications from about 50 to 150. In our laboratory, compound binocular microscopes, provided with water-immersion objectives, have permitted observations up to ×550.

Irwin and Macdonald (*26*) made a significant contribution to the microscopic study of living structures in mammals. They adapted tracheal insufflation techniques, thereby making it possible to reduce or stop gross respiratory motions, nearly eliminating these motions from the minute structures that were being observed. Rappaport, working in our laboratory during July 1956, devised an arrangement which still further reduces the motions of mammalian structures. He arranged intra-abdominal polyethylene aprons under which Ringer's solution was run through a narrow polyethylene tube, thereby maintaining a constant intra-abdominal pressure. By using both of the aforementioned techniques simultaneously, it is now possible to focus a water-immersion lens on a single outlet sphincter and keep that structure in focus at as much as ×550 magnification for several hours at a time.

When it is properly illuminated, the sphincter material has a translucent appearance, sharply different from that of the surrounding hepatic parenchyma. With our light source (a tungsten-fila-

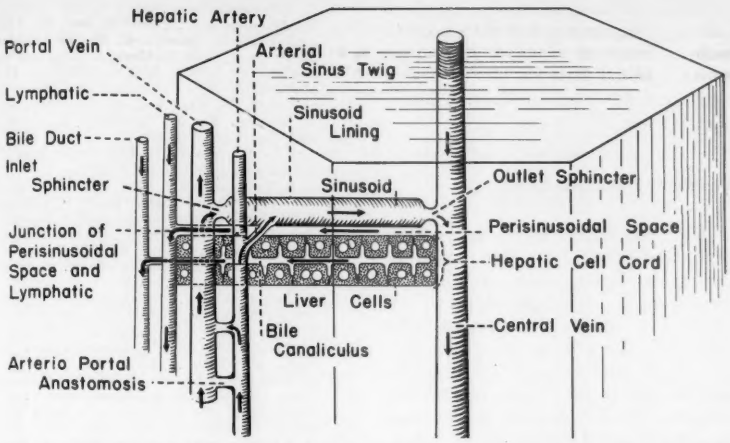

Fig. 1. Frog liver lobule. Each of the kinds of structure present in the lobule and the interrelationships between them are shown. Multiple interrelationships of items of the same kind are not shown—for instance, the well-known branching and anastomosing of sinusoids. Note the positions of (i) the inlet sphincter, at the point where the sinusoid joins the afferent intralobular portal venule, and (ii) the outlet sphincter at the junction of the efferent end of the sinusoid and the central vein of the lobule.

ment, motion-picture projection bulb operated at somewhat less than its rated 120 volts), the contractile tissue sometimes has a translucent golden color.

When illuminated by near-ultraviolet light from a General Electric Mazda A-H-5 lamp, transmitted to the liver by a quartz rod, the contractile inlet and outlet tissue of frogs fluoresces quite differently from the parenchyma. The contractile tissue becomes a greenish-gold color. (This is a "natural fluorescence"; no dye has been given the animal.)

In frogs, an injection of 0.6 milliliter of 0.5-percent trypan blue (dissolved in distilled water) into the dorsal lymph sac stains the hepatic parenchyma tissue sharply but leaves the sphincter material completely unstained.

Inlet Sphincter Function

In frogs, the inlet sphincters play a significant role in the "autotransfusion reaction." Knisely, Bloch, and Warner (7) described their observations of this reaction as follows: *"The Autotransfusion Reactions*: When a lightly anesthetized frog, which has a moderate to large percentage of its hepatic sinusoids storing blood or concentrated blood cells, has a moderately rapid hemorrhage from any part of its body, the terminals of the hepatic arterioles and portal venules and the inlet sphincters constrict tightly shut, the outlet sphincters open, the sinusoid linings constrict (often peristaltically from the periphery of the lobule toward the center), thus ejecting the contents of the sinusoids into the central veins. Thus the animal 'gives himself a blood transfusion.' The outlet sphincters then close, which prevents backflow into the sinusoids. The central and sublobular veins may also constrict somewhat (but usually not tightly shut) thus ejecting a little more blood. The whole autotransfusion is a precisely coordinated reaction of the individual structures which participate. In well nourished lightly anesthetized animals the blood is actively ejected by contraction of the sinusoid linings. The evidence is that the sinusoids may be completely empty and contracted so tightly that they have no lumen at the end of the ejection."

As far as is now known, blood does not pass from the portal vein bed into the liver without passing through the hepatic inlet sphincters. Note that during the autotransfusion reaction just described blood stored in the liver was forcibly ejected during a time that hepatic inlet sphincters prevented portal vein blood from entering the liver. Anatomically, the inlet sphincters of other species stand in a position which would permit controlled emptying of the liver without emptying of the portal vein bed and tributaries through the liver. Other than the foregoing, we have no clear-cut concepts of the functions of inlet sphincters, either for hepatic or for general circulatory physiology. Obviously, the functions of the inlets are now open for investigation.

Hepatic Outflow Control Mechanisms

When a segment of hepatic vein contracts tightly shut, it stops the outflow of blood from a relatively large volume of liver tissue. When a sublobular vein contracts, it can cause the storage of blood in one or more whole lobules. When a Deysach "small sluice channel" closes tightly, it can cause the retention of but a small amount of blood in the relatively few sinusoids which drain through it.

The individual sinusoid outlet sphincters of frogs can all open widely at once or take turns individually, opening and closing, relaxing and contracting; or various numbers of them may remain partially, tonically, contracted; or various numbers may all close at once. (These activities have been recorded in motion pictures taken through the microscope.) The outlet sphincters thus provide precise control of the flow of blood out of each and every sinusoid of the frog liver (for details, see Knisely, Bloch, and Warner, 7). Detailed knowledge of the behavior of sinusoid outlet sphincters in mammals is not yet available.

By and large, the four or five separate outflow control mechanisms have been discovered and studied during separate investigations, which usually employed quite different methods of study. Consequently, the knowledge that a given species has a certain type of outflow control mechanism does not indicate that the other mechanisms are absent in that species. Note that at least four of the mechanisms have now been found in dogs.

In various papers and reviews describing efforts to discover hepatic outflow control mechanisms, it is sometimes pointed out that "the mechanisms are absent" in one species or another. Careful reading of many of the original papers clearly shows that the investigators have not always determined whether they found the hepatic outflow mechanisms absent, or whether the methods they used failed to detect their presence.

As previously noted, Krogh and Lindhard (*15*) and Krogh (*16*) demonstrated that *human* liver and portal vein bed store and release blood and thereby limit and control the rate of filling of the heart, and thus the cardiac output.

As is well known, in many organs—human skin, for instance—there are direct vascular capacity changes as various numbers of arterioles, capillaries, or venules change caliber during different phases of functions of the organs. Further, every movement of fluid in or out of the vascular system acts toward changing the capacity of the system. If an animal's vascular system is to function as a competent hydraulic machine, it must have blood depots which can respond to the summations of all the direct and indirect changes in the capacities of the peripheral parts of the system.

Blood returns to the right heart by three major pathways: the superior vena cava, infrahepatic inferior vena cava,

and the hepatic veins which drain the liver, portal vein bed, and spleen. Various tributaries of the superior and inferior vena cava have flap valves which permit forward blood flow and stop back flow. The hepatic outlet control mechanisms stand as throttle valves controlling the outflow from the great hepatic and portal vein bed blood reservoir; they are the only known contractile structures which can dam back fairly large volumes of blood and restrict or stop the flow of that blood toward the right heart.

Portocaval Anastomoses

Currently, it is often assumed that no blood can pass from the liver and portal vein bed to the vena cava without passing through the hepatic veins. Were this true, the blood from the liver and portal vein would have to pass through one or more of the hepatic outflow control mechanisms. However, there are in human beings, and perhaps in other species, known collateral connections between the portal vein or its tributaries and the inferior vena cava. No single current textbook of human gross anatomy lists all of these. Comer and Knisely (*29*) present a list of known collaterals in man, collected from the original literature (see also *30*). The total numbers and total cross-sectional areas of the collateral connections between portal vein and vena cava are not known for any species, nor are their normal functions and vasomotor control mechanisms known.

One of us (M. H. K.) recently was present at the autopsy of a 20-year old previously healthy man who had been killed 10 hours before by a single stab wound in the upper right thorax. From rather cursory examination of the vessels of the portal vein bed and collaterals to the inferior vena cava, he is of the opinion that the whole topic of portocaval anastomoses in the healthy normal human being now needs rigorous reinvestigation. One problem is to be sure to distinguish an anastomosis which is a part of healthy normal anatomy from one which developed as a consequence of, or as a part of, circulatory pathology of the abdominal territory. For this, resort to histologic sections may be necessary. The information currently in elementary textbooks of human anatomy is not useful for this purpose; it was not collected for the specific purpose of making it possible to understand the structure and function of normal human beings. As noted, when attempting to understand normal and pathologic physiology, the presence of portocaval anastomoses in *normal healthy* men is frequently unknown, ignored, or forgotten.

Those who are interested in the control of cardiac output should read the detailed and comprehensive analysis of the literature dealing with the blood-cell reservoir functions of the spleen, and the blood reservoir function of the hepatic veins and the liver, in Knisely, Bloch, and Warner (*7*).

Reservoir Retention Shock

The "pooling of blood" in the liver and portal vein bed has been thought to be a major factor in some, not all (see Knisely *et al.*, *31*) types of circulatory shock. The forcible closing of adequate numbers of one or more types of hepatic and portal outflow control mechanisms can be one factor which initiates the pooling (*13*). The plugging of enormous numbers of small hepatic blood vessels, sinusoids, intrahepatic radicles of the portal vein and hepatic artery, and so forth, with masses of agglutinated blood cells is another mechanism which can initiate the "pooling of blood" in the liver and portal vein bed.

Conclusion

We now need to know the following:

1) A great deal more about the numbers, total cross-sectional areas, histologic construction, vasomotor control, and normal functions of the portocaval anastomoses in each of a series of species.

2) The cytological characteristics of various contractile sphincter mechanisms of the liver [Warner (*32*) reported structures (in guinea pigs) similar to smooth muscle cells surrounding the sinusoids efferent ends; these cells contained fibrils similar to myofibrils (see also Arey *et al.*, *12*)].

3) The physiological reactions in which the hepatic sphincter mechanisms continually participate (for the currently available information, see Knisely, Bloch, and Warner, *7*).

4) The neurological and hormonal mechanisms which normally control the hepatic sphincters.

5) How the various types of outflow control mechanisms take turns operating and otherwise coordinate their activities.

6) Pharmacological and therapeutic agents which will cause each type of sphincter in each species to contract or to relax (for a beginning of this, see *11, 19, 22, 33*).

7) The responses of each type of sphincter mechanism to noxious stimuli applied to the whole animal, such as hemorrhages, both rapid and short, and long and slow; and also the responses to severe burns, crushing injuries, experimentally induced infections, or perhaps even to just a severe fright.

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R. Wartenberg, Neurologist and Self-Ordained Critic

A law unto himself, Robert Wartenberg was a lively mixture of diverse characteristics. He was warm, kindly, egotistical, vain, a devoted friend, a feared adversary, and as loud in praise as he was vehement in criticism. He had a special aversion to mediocrity.

I can readily recall Wartenberg on a typical visit to our home for dinner. He proceeded at once to the bookshelves, carrying on conversation while nervously, yet earnestly, removing one book on neurology after another, to page through. "That dumb dope," he would say with impish laughter. "Look at the errors on this page! Why didn't he send me his manuscript before it went to press, as the others have been doing? The entire stock of this edition should be reduced to ashes." Or, in glancing through another book, he would charge that the author had not read a reference alluded to: "No, the description of Lasègue's sign wasn't published by Lasègue but by his pupil Forst." Or, again: "How stupid can a man get? I wrote a review of that book recently, and if I had told all the truth, the British would have withdrawn their ambassador from Washington."

At dinner, his wife, Isabelle, Baroness von Sazenhofen (of Freiburg, Germany), as gay and witty as he, would help him embellish recent Wartenberg exploits. He would tell, for instance, of an acrimonious letter he had written to the Surgeon General on the term *neuropsychiatry,* which was still in use in the armed services, then tell of the evasive reply, while she would elaborate on her husband's dislike of this bastard term, saying that neurology is not a form of psychiatry but that each is a separate discipline, able to care for itself.

Wartenberg also enjoyed poking fun at himself, at his foibles, at his totally bald head. He was eternally ebullient and alarmingly candid. "Ach!" he would say in his gutteral voice, "no von could be more vain than I," and he would then proceed to relate his successes with his students, to whom he referred as "my old teachers." It is true that no faculty member at the University of California at San Francisco—where he held forth from 1936 until his death on 16 November 1956, at the age of 69—was more popular with the students than he, and that no other lectures were more enthusiastically attended. He had the faculty of entertaining not only the audience but also the patients who were brought before him. On appropriate occasion he would even allude to the latest antics of his dachshunds or his goldfish. He was an actor and looked the part, with a build, stance, and vigor that recalled Mussolini in his better days. But there the comparison ends, for, as his biographer, Francis Schiller, wrote, "his . . . approach . . . was completely devoid of pomposity and full of jocular, common sense philosophy."

When Wartenberg came to San Francisco he was already in his prime. From the ancient Lithuanian town of Grodno, where he was born in 1887, he advanced through the universities of Kiel, München, Freiburg, and Rostock, to become assistant to such distinguished neurologists as Cassirer (Berlin), Nonne (Hamburg), and Foerster (Breslau). In 1933 he received a professorial post at the University of Freiburg. At the University of California he started once more at the bottom of the ladder and eventually (1952) became clinical professor of neurology; in 1954 he was made professor emeritus.

His perspicacity in all matters neurological won him membership on the editorial boards of eight journals, and the esteem he had earned internationally brought him, in 1952, the recognition most prized by a German professor—a *Festschrift*—which contained no less than 59 articles by 75 authors. An addict to hyperbole, he wrote of this tribute: "This is a super-duper-ultracolossal-mammoth volume. It is immoral, illegal, and ego-fattening to accept this attention. I will soon be committed to a state institution with the diagnosis amentia, with ideas of grandeur."

If Wartenberg's chief scientific contribution could be epitomized, I would say that it consisted of clarifying the principles of diagnosis of neurological diseases by sweeping away smothering complexities and ambiguities. Students and physicians at large could readily grasp the core of neurological examination after Wartenberg had stripped it of its encumbrances and soporific qualities. More life was thus brought into clinical neurology.

Wartenberg was master of the reflex hammer. Of his 158 sallies into the world of literature, perhaps the most outstanding was his book *Examination of Reflexes,* which was translated into seven languages. Here eponyms fell right and left as he supplanted them with anatomical terms that had real meaning. Ruthlessly, he eliminated many reflexes that had no significance. New ones of his own, he added.

An equally successful volume was *Diagnostic Tests in Neurology.* This work, with its clipped phrases and telegraphic style (Wartenberg trademarks), brought clinical neurology into the ken of any inquiring physician. Here one finds fresh observations as well as some which date back many years—for example, on ways of uncovering extrapyramidal disturbances resulting from the epidemic encephalitis which occurred in the wake of World War I. Furthermore, in this book he dwells on a theme which was one of his fortes: that some neurological diseases, such as facial hemiatrophy, are not of lower motor neuron origin, as had been alleged, but are due to alterations in upper motor neurons. He also brings harmony into the relation of "release" to the development of associated movements. Wartenberg's final contribution, on neuritis and neuralgia, which wore away his health and was completed 2 hours before his coronaries and cerebral vessels gave way, is ready for the press. It is as scholarly as the rest, although all may not agree with its emphasis on infection as a causative factor.

No refugee from Nazism who reached these shores adopted more quickly than Wartenberg the American way of life and thought—and the vernacular. No one in his time was a greater champion of the cause of neurology.

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News of Science

International Committee on Laboratory Animals

The world demand for laboratory animals continues to increase enormously, especially for specialized strains and for animals of uniformly high quality. Unless proper steps are taken, it is certain that progress in experimental biology and medicine will be delayed or hindered. In addition to the many national problems of laboratory animal supply and use, there are many of a universal nature which could best be solved on a coordinated international basis.

Consultants on laboratory animals who were convened by UNESCO in Paris last December recommended formation of an International Committee on Laboratory Animals. Such a committee was established under the auspices of the International Union of Biological Sciences (IUBS), UNESCO, and the Council for International Organizations of Medical Sciences (CIOMS), which includes the International Union of Physiological Sciences, the International Union of Biochemistry, and the International Union against Cancer. The new committee was formed from a reorganization of a Committee on Laboratory Animals that IUBS established in Rome in April 1955, and from a program established by UNESCO based on recommendations of the Cell Biology Program of CIOMS in December 1955.

The International Committee on Laboratory Animals consists of: a representative of IUBS, Sven O. Hörstadius, president of IUBS, chairman of the committee; W. Lane-Petter, director, Laboratory Animals Bureau, Medical Research Council, United Kingdom, honorary executive secretary of the committee; M. M. Sabourdy, director, Centre de Selection des Animaux de Laboratoire, Centre National de la Récherche Scientifique, France; Dale W. Jenkins, chairman, Institute of Laboratory Animal Resources, National Academy of Sciences–National Research Council, U.S.A.; a representative of CIOMS, to be appointed; and a representative of UNESCO, to be appointed.

At present, the committee is surveying laboratory animal sources and utilization in the United Kingdom, the Benelux countries, France, Italy, and Scandinavia, including Finland and Iceland. Additional countries will be surveyed in the near future. The committee is patterning its activities on an international scale after the programs of the Institute of Laboratory Animal Resources of the NAS–NRC (U.S.A.) and the Laboratory Animals Bureau of the Medical Research Council (U.K.). It is attempting to stimulate formation of similar organizations in other countries.

The aims of this international committee are to insure adequate supplies of uniform, high-quality laboratory animals and to determine the action required to prevent any serious shortages from arising. A world list of strains of laboratory animals is being compiled and a documentation center will be established. The common terms used in relation to laboratory animals are being defined precisely and quantitatively with regard to genetics, disease and parasitism, nutrition, care, and performance records. These terms will be standardized on an international basis.

The committee will prepare a report on the customs, quarantine, and other regulations concerning international shipment of laboratory animals, and formulate recommendations for proper conditions of transportation. The committee will also determine the need for establishing an information exchange; an educational program for animal technicians and caretakers; internationally recognized standards for laboratory animals, and systems for certifying animals and for accrediting of suppliers.

Johns Hopkins

The Johns Hopkins University School of Medicine has announced an extensively revised program of medical education that will cut 2 years off training time for specially selected students and 1 year for all other students. A total of $10 million to finance the plan has been received from the Rockefeller Foundation, the Ford Foundation, the Commonwealth Fund, the U.S. Public Health Service, and various private sources.

The money will provide for the construction of a new basic-science building at the medical school and the support of additional faculty. The plan will probably be put into effect on completion of the building in the fall of 1959.

The objectives of the new program have been stated as follows: (i) to shorten the formal education of physicians without sacrificing quality of training; (ii) to overcome the barrier between the liberal arts and medical sciences by enabling students in medical school to continue studies in the humanities and social sciences; (iii) to encourage more students to enter careers in the basic sciences of medicine—such as physiology, anatomy, and pharmacology—where the greatest shortages of teachers and research workers now exist.

Selected candidates of adequate "motivation and maturity" will be permitted to enter medical school as full graduate students after only two years of college, while continuing their college education. Other students may enter after 3 years of college, and still others after the complete 4 years of college.

Those who are accepted after 2 years of college wil take a 5-year course in medical school. They will continue studies in the liberal arts during the first 3 years of medical school, at the end of which they will receive a bachelor of arts degree. Students accepted after 3 or 4 years of college will begin medical school with the second year of the 5-year program. For all students the last year of medical school will be combined with the first year of internship in the Johns Hopkins Hospital, where each student will go through the major clinical services in turn, performing the duties now done by interns.

In addition to the usual 24-hour responsibility for patients, the student will be given a 2-month elective period for special work in basic science or additional clinical training in any one of the various departments of the hospital. He will pay tuition but will receive board and lodging, or their equivalent, in return for services to patients. At the time of graduation each student will have completed not only the required work in medical school but also a year of hospital internship.

While the years of medical training are cut, the actual period of training is shortened relatively little. In certain respects it will be more intensive than at present, for the academic year will be increased from the present 32 weeks to 40 weeks, and in the fifth year the training will cover 50 weeks.

The combined resources of the faculties of medicine, hygiene, and philosophy will become more widely available to graduate students in the basic medical sciences. This factor, combined with the shortened time required for formal education, should enable Hopkins to train an

increasing number of qualified teachers and investigators in those fields. The schedule will provide generous allotments of free time so that students can engage as actively as possible in research during their formative years in medical school.

Shortened time for medical education will mean a cut in the total cost of training. Earlier completion of training will enable more students to obtain optimal postgraduate training in hospital residencies.

National Science Policy

The following suggestions for an adequate national science policy are discussed in a recent issue of the *Saturday Review* by Sidney Hyman, *Washington Post* reporter:

"A Secretary of Science in the Presidential Cabinet ought to be considered. Failing it, the very least we can ask is a Science Commission on the same level of prestige and authority as the Bureau of the Budget, the Council of Economic Advisors, and the National Security Council. On this Science Commission the National Science Foundation should be represented alongside major department heads, including the Secretary of State. And the Secretary of State in that position should be the channel for Science Attachés in American embassies to acquaint the President with impacts of science abroad. . . .

"As a Congressional offset to the growing autonomy of a science-entrenched Executive one thing is plainly needed. It is a Joint Congressional Committee on Science, backed in depth by a technical staff. . . ."

Radiation Protection Group Appoints New Executive Committee

The National Committee on Radiation Protection and Measurements (NCRP) has announced a change in the membership of its executive committee. Within the operating procedures of the NCRP, the executive committee is responsible for the broad policies and direction of the work of the committee, and its membership is selected to provide as broad representation as possible of the many disciplines that are involved in the philosophy and development of radiation protection.

Sponsored by the National Bureau of Standards, the NCRP is an advisory group of experts in various phases of the radiation field and is made up of representatives from the following organizations: American College of Radiology, American Dental Association, American Industrial Hygiene Association, American Medical Association, American Radium Society, American Roentgen Ray Society, International Association of Government Labor Officials, National Bureau of Standards, National Electrical Manufacturers Association, Radiological Society of North America, U.S. Air Force, U.S. Army, U.S. Atomic Energy Commission, U.S. Navy, and U.S. Public Health Service. The recommendations of the committee are published by the U.S. Government Printing Office in the NBS Handbook series.

The members of the new executive committee and their institutional affiliations are as follows: L. S. Taylor, chairman, Atomic and Radiation Physics Division, National Bureau of Standards; E. C. Barnes, Industrial Hygiene Department, Westinghouse Electric Corporation; C. B. Braestrup, Physics Laboratory, Francis Delafield Hospital (City of New York Department of Hospitals); C. L. Dunham, Division of Biology and Medicine, U.S. Atomic Energy Commission; H. Bentley Glass, Department of Biology, Johns Hopkins University; H. M. Parker, Hanford Laboratories, General Electric Company; Clinton Powell, Division of Special Health Services, U.S. Public Health Service; Robert S. Stone, Medical Center, University of California; Shields Warren, Cancer Research Institute, New England Deaconess Hospital.

Training in Steroid Biochemistry

Applications are now being accepted for the second course in the Training Program for Steroid Biochemistry, a program that is conducted through the cooperative effort of the Worcester Foundation for Experimental Biology, the department of chemistry of Clark University, and the department of biochemistry of the University of Utah. The program is sponsored by the National Cancer Institute to provide specialized training for people interested in steroid investigation. Two groups of candidates will be selected and will receive stipends during the period of training.

Postdoctoral candidates having an M.D. or Ph.D. degree will receive $5000 for 1 year starting 1 Oct. 1957. The training will consist of laboratory sessions and lectures covering theoretical and practical aspects of steroid research, and an opportunity to engage in a research problem under an established investigator.

Candidates having a B.S., M.S., or equivalent degree will receive $1500 for a 6-month training period, 1 Oct. 1957 through Mar. 1958. The predoctoral program is intended to provide competency in the analysis of steroid compounds for research and clinical laboratories.

The closing date for applications is *15 Aug.* Requests for applications should be made to Dr. Kristen Eik-Nes, Department of Biochemistry, College of Medicine, University of Utah, Salt Lake City, Utah, or to Dr. Frank Ungar, Department of Chemistry, Clark University, Worcester, Mass.

Reynolds Memorial Fund

The faculty of the department of biology at the University of Virginia has started a memorial fund in the name of the late Bruce D. Reynolds. Interest on all money collected will be applied to an annual fellowship for each season of the Mountain Lake Biological Station. Reynolds was instrumental in founding the station in 1930, and he resigned as its director last fall. Checks should be made out to the Bruce D. Reynolds Memorial Fund and mailed to the secretary of the fund, Biology Building, University of Virginia, Charlottesville, Va.

$5000 Hoblitzelle Award in Agriculture

The Hoblitzelle national award in the agricultural sciences, consisting of $5000 and a gold medal to the person who has made the most important scientific contribution to American agriculture for the preceding 4-year period, will be presented in May 1958. The contribution meriting this award must have been published in the period from 1 Jan. 1953 through 31 Dec. 1956. There is no intention of excluding research that may have been initiated earlier, but the results must have been published in those 4 years. Popular articles, mimeographed progress reports, and digests are not generally considered as complying with the standards of the award.

All nominations will be channelled through regional committees. There will be a committee in each state to cover the continental United States, and one each for Alaska, Hawaii, and Puerto Rico. In performing its function, each committee is requested to give equal consideration to all scientists, irrespective of creed, color, nationality, age, branch of science, or affiliation with scientific or scholastic organization.

Nominations may be made by the regional committees or by individuals, groups, or agencies. The nominator must furnish the regional committee with five copies each of the following items: the publication or publications on which the nomination is based; a written evaluation of the nominee's contribution and its national significance to agriculture; a short biographical sketch of the nominee; and such other information as he may feel is necessary to support the nomination. In making nominations it

should be kept in mind that the award is given as recognition of specific research and not in recognition of a man's career in science. The research must have potential national significance to agriculture.

Each committee will receive nominations, evaluate them, and forward three selections to Fred M. Shaw, Secretary, Hoblitzelle Awards, Texas Research Foundation, Renner, Tex. Nominations must be received by the Texas Research Foundation *not later than 1 Nov. 1957*. Further information may be obtained from Shaw.

The Hoblitzelle Foundation, the donor of this award, was established by Karl Hoblitzelle in 1942 "exclusively for charitable, scientific, literary or educational purposes. . . ." Hoblitzelle, a resident of Dallas, is a businessman, financier, and philanthropist.

NSF Research Data

The National Science Foundation has initiated a new series of brief reports under the general heading *Reviews of Data on Research and Development*. The first report is a 4-page leaflet dealing with "Expenditures for Research and Development in the United States, 1953." In a graphically illustrated text, the release shows that the Federal Government contributed 52 percent, and industry 44 percent, of the $5370 million available for research and development in that year. Industry, on the other hand, carried out 72 percent of the actual work, whereas the Government assumed responsibility for only 18 percent. Colleges and universities provided financial support for only 3 percent of the total, yet they performed 9 percent of the research and development done.

The National Science Foundation is using this new medium to provide advance summaries of work in progress. Soon to appear are reports on "Expenditures for Research in Medical Schools, 1953–54," and "Expenditures for Research in Colleges and Universities, 1953–54."

New Oceanography and Ornithology Laboratories for Yale

Yale University will begin construction this summer of a $650,000, two-story wing of the Peabody Museum that will house the Bingham Oceanographic Laboratory and the Ornithology Laboratory. The laboratories are scheduled for occupancy in January 1959.

The new structure has been made possible by generous donations from Wendell W. Anderson, Allan Shelden 3d, William W. Shelden, and Thomas Shevlin. In addition, the ornithology part of the building, established by a substantial bequest from the late William Robertson Coe, is the culmination of many years of planning to enhance research and collections in ornithology. The late Harry Payne Bingham, who started the Bingham laboratory many years ago with extensive gifts of his own collections and funds to support and build them, also left a sizable sum to Yale for the eventual construction of the wing.

34,000-Year-Old Skeleton

The Smithsonian Institution has announced that an adult human skeleton has been found 14½ feet below the surface in the top Mousterian layer of the Shanidar Cave, in northern Iraq. Ralph S. Solecki, Smithsonian collaborator and archeologist-leader of the Smithsonian-sponsored expedition to Iraq, reports that no exact age can be given for the skeleton, but the layer in which it was found is known to be over 34,000 years old.

Solecki first visited the Shanidar Cave in 1951. So promising were his initial excavations that he arranged to return for ten weeks in the summer of 1953. It was during the second expedition that Solecki found a child's skeleton at a depth of 26 feet from the surface. A recent study of the teeth of the Shanidar child indicates that it belongs to a new form of Mousterian or Upper Pleistocene man. Since the newly discovered adult comes from a higher level in the cave, it may represent a still different type of man.

Solar Energy Center

A Solar Energy Center will be built at Tierra del Sol, Calif., a townsite owned by J. Y. Leveque, sponsor of the new project. Leveque, a San Diego and Los Angeles management consultant specializing in the aircraft and oil industries, undertook the new venture with the backing of eastern businessmen. Construction will begin shortly. The center will be privately financed, and will aim at obtaining research and development contracts from Government agencies and industrial firms.

Tierra del Sol, on the Tecate Divide 65 miles east of San Diego, is 3800 feet above sea level. The site is close to much higher and much lower altitudes where experiments can be conducted under a wide variety of climatic conditions. The smog- and fog-free site receives sunshine almost every day of the year and has easy access to good highway and rail facilities.

The purpose of the center will be to develop practical uses for solar energy. A solar furnace, capable of reaching temperatures in excess of 6000°F, will eventually be built for the project. It will be used for testing and heat-treating.

In addition to the construction of suitable laboratory facilities, everything possible will be done to keep Tierra del Sol in character with the Solar Energy Center. A model home will be built that uses solar energy for heating and hot water, and street lights will be equipped with solar batteries. A solar pump, to be imported from Italy, will be installed on a well that is about to be drilled.

An exhibit of various solar-energy applications, collected from all over the world, will be open to the public. In addition, scientists from various countries will be invited to visit the center.

One of the first projects to be undertaken will be research in the application of solar energy as a means of sea-water conversion. Sea water will be shipped by rail from San Diego for this purpose.

Films for Junior High Schools

To stimulate the interest of teenagers in science as a possible career field, the McGraw-Hill Book Company, New York, has released a junior science film series. The series, a program of 39 films, each about 13 minutes in length, has been planned with the junior-high-school curriculum in mind. While maintaining a sound educational approach, these films are geared to lead the students to appreciate the advantages offered by careers in science.

Using equipment and materials readily available, each film deals with a basic scientific principle and relates it to ordinary life. For example, through the medium of film, a toy locomotive demonstrates Newton's third law of action and reaction; children playing on a seesaw are transformed into a lever diagram; and a cowboy's lariat illustrates centrifugal force.

News Briefs

The schedule is now available for the laboratory refresher training courses that are to be offered by the U.S. Public Health Service Communicable Disease Center during the period 9 Sept. 1957–28 Mar. 1958. Information and application blanks may be secured from the Laboratory Branch, Communicable Disease Center, U.S. Public Health Service, P.O. Box 185, Chamblee, Ga.

* * *

The Air Research and Development Command has established a new Development Field Office in the San Francisco Bay area to provide a close link between

the Command and the private research institutions and industries of that area. At present the office is located at Moffett Field, Mountain View, Calif., although its permanent home will be in or near Palo Alto. Capt. Otis R. Hill, formerly of ARDC Headquarters in Baltimore, Md., is in charge of the new office.

* * *

International Business Machines Corporation has announced the opening of its first radioisotope laboratory. Located at IBM's Product Development Laboratory in Endicott, N.Y., the new equipment provides instrumentation for radio chemical studies of machine parts such as bearings, electrical contacts, and gears, and for radiographic analysis of such components as heavy machine castings.

* * *

Awards totaling more than $1 million have been allocated for heart research this year by the Life Insurance Medical Research Fund. This is the first time that the annual awards have passed the $1-million mark. In all, the Fund has given $9,211,000 for heart research since it was organized in 1945, including the 1957 awards of $1,059,490. The awards are of two types: grants to research institutions to support specified basic research projects; and fellowships to promising young men and women for training in heart research.

* * *

The National Science Foundation has announced 235 grants totaling $4,316,352 awarded during the quarter ending 31 Mar. 1957 for the support of basic research in the sciences, for conferences in support of science, for short-term research by medical science students, for exchange of scientific information, and for training of science teachers. This is the third group of awards to be made during fiscal year 1957. Since the beginning of the program in 1951, 3401 such awards have been made totaling almost $54,300,000.

Heavy-Ion Linear Accelerator

The Atomic Energy Commission has announced that a new type of linear accelerator designed for study of the elements and isotopes in the transuranic region has gone into operation in the University of California Radiation Laboratory. The machine is now accelerating nuclei of nitrogen atoms (nitrogen-14) to energies of 140 million electron volts.

The new instrument does not compete in energy with such powerful machines as the Radiation Laboratory's bevatron, which accelerates protons—the nuclei of the lightest element, hydrogen—to 6.2 billion electron volts. In contrast, the new facility is designed especially to accelerate the nuclei, or ions, of very heavy atoms. It is therefore called a heavy-ion linear accelerator, or HILAC.

The machine represents, in part, a joint project between the University of California and Yale University. Yale and Berkeley scientists developed the design of the machine, a duplicate of which is nearing completion now in New Haven. The research emphasis at the two institutions will be different: Yale is chiefly interested in problems in physics and Berkeley is giving priority to chemical transmutation experiments.

Chester Van Atta, physicist in the Radiation Laboratory, Berkeley and Livermore, has been in over-all charge of the Berkeley development, which has been under the immediate supervision of Edward Hubbard, physics. At Yale, Robert Beringer is in charge of the machine's development.

Proposed Legislation

Of the many bills introduced in Congress, some have a special relevance to science and education. A list of such bills introduced recently follows:

S 1552. Authorize Secretary of Agriculture to establish a program for purpose of carrying on research and experimentation to develop methods for commercial production of fish on flooded rice acreage in rotation with rice field crops. Fulbright (D Ark.) Senate Agriculture and Forestry.

S 1628. Provide further protection against dissemination of diseases of livestock or poultry. Ellender (D La.) (by request) Senate Agriculture and Forestry.

HR 5857. Amend Soil Bank Act to permit grazing land to be included in conservation reserve program. Albert (D Okla.) House Agriculture.

S 1572. Authorize appropriations for Atomic Energy Commission for acquisition or condemnation of real property or any facilities, or for plant or facility acquisition, construction, or expansion. Anderson (D N.M.) Joint Committee on Atomic Energy.

HR 6212. Provide for national scholarships for college and university undergraduate study. Porter (D Ore.) House Education and Labor.

HR 5932. Establish U.S. Commission on Aging and Aged. Fulton (R Pa.) House Education and Labor.

H J Res 270. Establish a U.S. Academy of Foreign Service. Dwyer (R N.J.) House Foreign Affairs.

S J Res 75. Propose amendment to Constitution of U.S. to prevent interference with, and eliminate limitations upon, power of states to regulate health, morals, education, marriage, and good order therein. Eastland (D Miss.) Senate Judiciary.

Scientists in the News

RICHARD M. GOODY, British physicist, will become professor of meteorology at Harvard University on 1 July. He also will succeed CHARLES M. BROOKS [*Science* **125**, 984 (17 May 1957)], who is retiring as director of the Blue Hill Meteorological Observatory. Goody is reader in meteorology at the Imperial College of Science and Technology, University of London. His research has included studies of temperatures in the stratosphere, thermal equilibrium, and the spreading of heat in the earth's atmosphere. He also has made studies of the atmosphere of Venus and the sun.

MAURICE EWING, director of the Lamont Geological Observatory of Columbia University and president of the American Geophysical Union, has received the union's 19th William Bowie medal. He is well known for his contributions to geophysical sciences, most notably perhaps in seismology and in the study of the ocean floor.

C. LALOR BURDICK, since 1946 secretary of the Polyfibers Committee of E. I. du Pont de Nemours and Company, Wilmington, Del., retired in April after 29 years with the company. As coordinating officer of the committee, Burdick has helped direct the development of policy for all Du Pont activities in the field of synthetic fibers, as represented by nylon, Orlon acrylic fiber, and Dacron polyester fiber. He has also been a member of the company's committee on fellowships and grants.

Burdick joined Du Pont in 1928 as assistant chemical director of the ammonia department. From 1939 to 1945, he was assistant to the president of the company. Then, for the year preceding his appointment to the Polyfibers committee, he served as chairman of the board of two Du Pont Latin American affiliates, Cia. Mexicana de Explosivos and Du Pont, S.A.

Through his association with the Lalor Foundation, which he has directed since its establishment in 1935 as a private organization to support research, Burdick has been closely identified with the promotion of research and education in the biological sciences.

Burdick was graduated in 1911 from Drake University, Des Moines, Ia., receiving the degree of bachelor of science in chemistry. From Massachusetts Institute of Technology he received a similar degree in 1913, and a year later his master's degree. Entering the Kaiser Wilhelm Institute in Berlin, Burdick remained until 1915 when he went to the University of Basel, Switzerland; there he received the degree of doctor of phi-

losophy the same year. In 1915 and 1916 he did special research at the University of Berlin, and University College, London.

During 1916 and 1917 he was research associate in theoretical chemistry, first at M.I.T. and then at the California Institute of Technology. He was metallurgical and research engineer for Guggenheim Brothers and then for the Chile Copper Company between 1919 and 1924, and from 1924 to 1928 he was vice president and consulting engineer of the Anglo-Chilean Consolidated Nitrate Corporation.

RALPH W. CHANEY, professor of paleontology in the department of paleontology at the University of California, Berkeley, and curator of the paleobotanical collections in the university's Museum of Paleontology, will retire on 1 July. He has been at the university since 1930. Prior to that date he was a research associate for the Carnegie Institution of Washington, a position he still holds; earlier still, he was on the staff of the University of Iowa. Chaney is well known for his studies of Tertiary plants in western America and eastern Asia.

WAYNE L. FRY, paleobotanist with the Geological Survey of Canada, has been appointed assistant professor in the department of paleontology and curator of the paleobotanical collections to fill the vacancies created by Chaney's retirement.

ARTHUR C. MENIUS, Jr., professor of physics, has been appointed head of the department of physics at North Carolina State College's School of Engineering. A member of the State College faculty since 1949, Menius replaced CLIFFORD K. BECK, who resigned the post last July but retained his rank as professor of physics. Beck is now on leave of absence with the U.S. Atomic Energy Commission.

KENNETH W. CHAPMAN has been appointed associate director of the Clinical Center, the combined clinical and laboratory research facility of the Public Health Service's National Institutes of Health, Bethesda, Md. Since 1946, Chapman has specialized in hospital administration, principally with the Public Health Service in Washington, D.C., where he served in several capacities. His most recent assignment was with the National Institute of Mental Health, where he was consultant to state and community hospitals and health services on the medical problems of narcotic addiction.

LORRIN A. RIGGS of Brown University received the Howard Crosby Warren medal and a cash award during the recent annual meeting of the Society of Experimental Psychologists that was held at Harvard University. Riggs was cited "for his extraordinarily fruitful techniques of recording electrical potentials from the human retina and for his many significant contributions to systematic knowledge and theory of vision that these techniques have made possible."

JONAS E. SALK, head of the department of preventive medicine at the University of Pittsburgh, has received the Howard Taylor Ricketts prize of the University of Chicago for "his contributions to basic research in the field of immunology and the practical utilization of this knowledge in the development of a vaccine for poliomyelitis."

MURRAY SANDERS, research professor and director of the department of microbiology at the University of Miami, has accepted an invitation from the Czechoslovakian Academy of Sciences to deliver a series of lectures in that nation during the coming summer. He will speak at Czech medical and research institutes on virus cultivation and virus research conducted at the University of Miami.

DMITRI BLOKHINTSEV, director of the U.S.S.R.'s new joint nuclear research institute, has received one of the 1957 Lenin prizes, as has ANDREI N. TUPOLEV, designer of the jet airliner Tu-104. The Lenin prizes are awarded by committees of the Soviet Council of Ministers for work in science, technology, literature, and fine arts.

EDWARD A. MARCEY has retired after 40 years of service with the National Institutes of Health and its predecessor the Public Health Service Hygienic Laboratory. A medical biology technician with the Laboratory of Infectious Diseases, he was NIH's oldest employe in point of service. He has been officially cited for outstanding performance of his duties.

At the National Bureau of Standards, RALPH P. HUDSON and ERNEST AMBLER of the cryogenic physics section and RAYMOND W. HAYWARD and DALE D. HOPPES of the radioactivity section have been awarded the Department of Commerce Gold Medal for Exceptional Service. The award recognizes their "outstanding contribution to science" in demonstrating the breakdown of the parity law in nuclear physics for weak interactions. The low-temperature experiments conducted at the bureau by these men demonstrated that the quantum mechanical law of conservation of parity does not hold in the beta decay of cobalt-60 nuclei, disproving a fundamental concept of nuclear physics that had been universally accepted for the past 30 years.

Recent Deaths

LAURENCE W. CODDING, Glen Ridge, N.J.; 58; electrical engineer; 30 April.

GEORGE H. DAVIS, Larchmont, N.Y.; 93; construction engineer and pioneer in the aircraft industry; 3 May.

SAMUEL R. DETWILER, New York, N.Y.; 67; professor and executive officer of the department of anatomy at the College of Physicians and Surgeons, Columbia University; 2 May.

WILHELM FILCHNER, Zurich, Switzerland; 79; German explorer who headed expeditions into Asia and Antarctica; 7 May.

A. ARTHUR HATCH, Easton, Pa.; 79; associate professor emeritus of mathematics at Lafayette College; 7 May.

JOHN JAY HOPKINS, Washington, D.C.; 63; board chairman of the General Dynamics Corporation; 3 May.

HUNG-CHIN CHOW, Taipei, Taiwan; 55; director general and acting director of the Institute of Mathematics in the Academia Sinica; visiting scholar in mathematics at Cornell University; 7 May.

HENRY A. HUSTON, Kew Gardens, N.Y.; 99; soil chemist who organized and headed the department of agricultural chemistry at Purdue University; 4 May.

ROBERT P. JACOBSON, Shrewsbury, Mass.; 50; senior scientist at the Worcester Foundation for Experimental Biology; 3 May.

JOSEPH W. KENNEDY, Ladue, Mo.; 40; chairman of the department of chemistry at Washington University; 5 May.

FRANK H. REED, Urbana, Ill.; 67; chief chemist of the Illinois State Geological Survey; 27 Apr.

ELNORA E. THOMSON, San Francisco, Calif.; 83; former president of the American Nurses Association and a leader in the fields of mental hygiene and public health who had been professor of applied sociology and director of health and nursing education at the University of Oregon School of Social Work; 24 Apr.

JOHN B. TRIMBLE, White Plains, N.Y.; 59; retired mechanical engineer; 29 Apr.

GEORGE M. WELLS, Upper Montclair, N.J.; 77; consulting engineer who assisted in the design and construction of the Panama Canal; 3 May.

ARTHUR M. YUDKIN, Woodbridge, Conn.; 65; clinical professor of ophthalmology at the school of Medicine, Yale University; 2 May.

Reports

Effect of Tetraploidy on Learning and Retention in the Salamander

The effect of polyploidy on learning in the salamander has been studied in the larvae of the newt *Triturus viridescens* (*1*). In that study it was found that the maze performance of a triploid (3n) animal was significantly worse than that of a normal diploid (2n) animal. The triploid condition in the salamander can be produced by subjecting the fertilized egg to a temperature of about 36°C for about 10 minutes during the meiotic division period. The temperature treatment brings about a suppression of the second meiotic division so that the normal complement of chromosomes is not reduced to the haploid number but instead effects the retention of both sets of chromosomes. Thus, when fertilization occurs there is an addition of an extra set of chromosomes. Offspring possessing three sets of chromosomes are known as triploid organisms (*2*).

The addition of the third set of chromosomes causes an increase by about 50 percent in the size of the cell nucleus, and since the cell size is roughly proportional to the nucleus there is also an increase in the cell size by about 50 percent. Despite the fact that the cells are larger, there is no change in over-all body size, a result which is brought about by a compensatory reduction in the number of cells (*3*). In the case of the triploid animals, the total number of cells is reduced by about 33 percent.

Tetraploid animals possess four sets of chromosomes, a condition which can be produced in the following manner (*4*). Triploid salamanders are usually sterile; however, the species *Amblystoma mexicanum* is something of an exception to this rule. The triploid *A. mexicanum* can be produced by the temperature method indicated in the first paragraph. These triploid animals mature after about 2 years instead of the usual 1 year, at which time about 50 percent of the females are fertile although they lay a greatly reduced number of eggs. When these eggs are fertilized by diploid males, about 3 percent of them will develop into tetraploid animals. Such a tetraploid animal has four sets (4n) of chromosomes; thus the cell nucleus is twice as large as normal and hence the cell size is also double the usual size. Once again, however, there is no change in the body size, which means a compensatory reduction in the cell number that must be by a factor of about 50 percent.

The purpose of the present study was to investigate the learning ability of organisms possessing very large brain cells. The animals were trained to perform a position habit on a water T-maze. They were motivated to traverse the maze in order to escape punishment which was applied in the form of tactual prodding at the tail region. A correct turn at the choice point rewarded the animal with 1½ minutes of rest, while an incorrect turn brought on a period of compound punishment, consisting of continued prodding plus the addition of a 200-watt light. Since the intensity of the prodding was only roughly constant, being administered manually by *E*, the animals were coded, and *E* was not informed of the nature of the code. The criterion of learning was ten consecutive errorless trials. The experimental group was composed of three mature tetraploid salamanders, and the control group was composed of four mature diploid salamanders, all of which were *Amblystoma mexicanum*. The water in the maze was maintained at 68°F.

From Table 1 it can be seen that the tetraploid salamander is a much slower learner than the normal salamander; the differences in their trials to criterion is significant at slightly better than the 5 percent level of confidence, and the difference in their errors is significant at the 1 percent level of confidence. Thus it may be concluded that tetraploidy in the *Amblystoma mexicanum* reduces maze learning ability. It may not be concluded that the poor learning performance of the tetraploid animal was due to its being less active or less responsive to the tactual stimulus for the following reason. The relative activity and reactivity of the animals was tested by a technique devised by Detwiler (*5*). The animals were placed in a circular maze, the bottom of which was marked off into equal sectors. The animals were prodded on the tail, and the number of sectors traversed per prod was recorded. This procedure was repeated 20 times for each animal in each group where *E* was again not informed of the nature of the coding of the animals. The Detwiler test revealed that the diploids traveled, on the average, 5.9 sectors per stimulus, while the tetraploids averaged 7.3 sectors per stimulus. The difference between these two means is *not* statistically significant, and if there is a trend at all it would appear to favor greater activity on the part of the tetraploids.

Seven days after each animal had reached criterion on the original learning task, it was retrained on the same maze for the same task to the same criterion. Table 1, under the heading "Relearning," presents the data on relearning. Note that both groups show some evidence of retention. This retention, when measured by the savings technique, is about 33 percent in both groups for trials to criterion. In the case of error scores, the diploids save about 32 percent, while the tetraploids save 50 percent. Thus, relative to their original learning, the tetraploids retain as well as the diploids.

The data of the present study reveal that the tetraploid condition has a detrimental effect on maze learning in the salamander. They complement earlier findings for the triploid condition in salamanders. Since these two studies are being compared, it should be pointed out that the mature *Amblystoma mexicanum* seems to learn a simple maze task much more readily than the larva of *Tri-*

Table 1. Trials and errors to criterion.

Positive maze stem	Trials	Errors	Relearning	
			Trials	Errors
Diploid control group				
R	40	6	33	5
R	47	14	11	1
L	34	11	36	13
L	51	13	36	11
Mean	43	11	29	7.5
Tetraploid experimental group				
L	125	42	85	24
L	67	31	56	19
R	78	36	39	12
Mean	90	36	60	18

All technical papers and comments on them are published in this section. Manuscripts should be typed double-spaced and be submitted in duplicate. In length, they should be limited to the equivalent of 1200 words; this includes the space occupied by illustrative or tabular material, references and notes, and the author(s)' name(s) and affiliation(s). Illustrative material should be limited to one table *or* one figure. All explanatory notes, including acknowledgments and authorization for publication, and literature references are to be numbered consecutively, keyed into the text proper, and placed at the end of the article under the heading "References and Notes." For fuller details see "Suggestions to Contributors" in *Science* 125, 16 (4 Jan. 1957).

turus viridescens. The present study also reveals that retention over a period of 7 days, when measured by the savings technique, was equal for diploid and tetraploid salamanders, a somewhat surprising result in view of the tetraploid's poor learning ability.

At this point, it appears safe to conclude that polyploidy, whether diploid or tetraploid, brings about a decrease in maze learning ability. It is not possible, however, to state whether such an effect is the result of the increase in cell size, the reduction in number of cells, or the reduction in number of neural connections that probably results from the reduced number of cells.

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26 February 1957

Observations on Local Spread of Pox Viruses in Tissue

In the course of experimental work on the local spread of pox viruses in the infected chorioallantoic membrane of the embryo, we frequently encountered (*1*, *2*) peculiar ring zones consisting of concentric rings around a central focus of infection (Fig. 1). In plants, ring-zone formation has been known for a long time. The ringspot viruses, which cause concentric necrotic and non-necrotic areas on infected leaves, are typical examples. As far as we know, similar findings with animal viruses have not been reported. The ring zones appear to be a suitable model for the study of the mode of local spread of virus in infected tissues. This report is a brief summary of our observations on this problem.

Our experiments were carried out with two strains of dermovaccinia, one of neurovaccinia, one of cow pox, one of variola, and two of fowl pox virus. All strains had been passaged in eggs more than ten times. Embryonated 10-day eggs were inoculated on the chorioallantoic membrane according to a previously described modification of Burnet's method (*1*, *3*). The amount of seed virus varied between 10 and 1000 minimal infective doses, and the membranes were harvested at various intervals before and after the death of the embryos. Our experimental material comprised nearly 1000 eggs. For macroscopic examination, the membranes were placed in Kaiserling solution and imbedded in glycerine gelatine. For histological study, they were fixed in phosphate-buffered formalin (4.37 percent by weight of formaldehydus solutus, *p*H 7.4) and imbedded in paraffin. The sections were stained with hematoxylin and eosin.

Macroscopically typical ring zones were found around both the primary and the secondary foci, the latter appearing after the generalization of the infection (Fig. 1).

The number and the intensity of the zones depended on the time of survival of the host: the longer the embryo survived, the more marked the ring zones. The zones were always more distinct and more constant with fowl pox than with the other pox viruses examined. This may be owing to the different character of the fowl-pox infection. The chorioallantoic picture, the much longer incubation period, the lower virus content of the affected tissues, the relatively high survival rate of the infected embryos, and the slower course of the infection differentiate fowl pox from the more active vaccinia, cow pox, and variola viruses in incubated eggs. For this reason, histological examinations were carried out only with fowl pox-infected chorioallantoic membrane.

The results obtained show that the ring zones in fowl pox-infected chorioallantoic membrane are caused by stepwise centrifugal spreading of the virus in the tissue. The phenomenon is the result of a complex process in which both the proliferating ectoderm with its concentric exfoliations and the entoderm with its concentric rampartlike proliferations play a part. The latter are particularly prominent at the periphery of the foci (Fig. 2).

There can be little doubt that the ectodermal exfoliations are primarily caused by the virus, while the viral cause of the entodermal proliferations is proved by the characteristic vacuolizing degeneration of the cells (Fig. 2). There is no fundamental difference between the primary and the secondary foci.

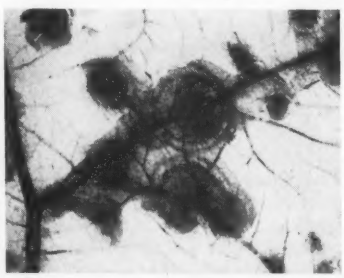

Fig. 1. Ring-zone formation around an older fowl-pox focus in the chorioallantoic membrane. Two dim rings show around the pocks. (×6)

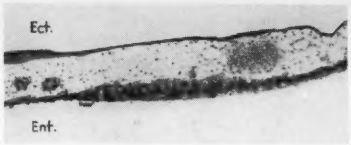

Fig. 2. Peripheral ring zone of a secondary focus of fowl pox. The rampartlike entodermal proliferation (Ent.) extends far beyond the altered zone of the ectoderm (Ect.). (×73)

Fig. 3. Cross-section through two rings at the periphery of a fowl-pox focus. Note that such rings are caused by entodermal proliferation exclusively (arrows point to the thickened entodermal areas). (×27½)

The appearance of rampartlike, almost undulated entodermal proliferations around some foci strengthens the concept of a local centrifugal spread of the virus from cell to cell connected with rhythmical differences in viral activity. In the course of spreading, the pathogenicity of the virus appears to be exhausted and restored periodically. Zones of high virus activity and marked tissue damage alternate with zones of low viral activity and little or no pathogenic effect.

This hypothesis of rhythmic virus spread is strengthened by the presence of shaggy ectodermal proliferations that appear at almost regular intervals. The extent of these proliferations is greatly reduced toward the periphery of a focus.

Of special interest in this connection is the fact that, in the course of generalization, the secondary virus implantation in the chorioallantoic membrane begins in the entoderm. In the ectoderm, there is extensive viral spread in the early stages of focus formation (Fig. 3). Later, especially in secondary foci, the peripheral proliferating ramparts in the entoderm extend far beyond the last ectodermal alteration (Fig. 2).

A striking feature of this intermittent local spread of virus is the fact that the intensity decreases toward the periphery and finally stops. In other words, the local spread of virus does not proceed unlimitedly, but is checked at a certain point. The reason for this phenomenon

is not known. To find the correct explanation would be an important contribution to a better understanding of the virus-cell relationship.

The possibility that the ring zones are the result of mesodermal cellular infiltration or that they are caused by external nonspecific stimulations or by antigen-antibody reactions could be excluded. On the other hand, it is not unlikely that the formation of ring zones is influenced to some extent by the alternating physiological condition of the eggs. This hypothesis is supported by the observation that pox viruses settle better in viable embryos than they do in fertilized eggs of low vitality. In the latter, the secondary foci do not show the same degree of development as in more viable eggs after the same period of incubation.

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11 February 1957

Hemagglutination Test for Toxoplasmosis

The *in vitro* dye test of Sabin and Feldman (*1*) is at present the most useful diagnostic procedure for toxoplasmosis. However, it has difficulties in its performance which make it unsuitable for use in most routine diagnostic laboratories. It requires live parasites, which are dangerous to handle, and it requires microscopic reading of the tests, large quantities of an accessory factor that is found in normal human serums and that is sometimes difficult to obtain, and considerable care in most of the manipulations involved. The reports of Middlebrook and Dubos (*2*), Boyden (*3*), Keogh *et al.* (*4*), Alexander *et al.* (*5*), Stavitsky (*6*), and others have demonstrated the applicability of the hemagglutination procedure to a variety of antigens, both polysaccharide and protein in nature. The technique has already been tested in parasitic infections, such as schistosomiasis and trichinosis, by Kagan (*7*). In an effort to devise a practicable test for the diagnosis of toxoplasmosis, we have explored the applicability of this procedure.

A number of *Toxoplasma* antigens have been prepared and tested in the hemagglutination test, using the following procedure. Toxoplasmas are harvested from the peritoneal exudates of intraperitoneally infected mice into a tared tube containing saline, buffered at *p*H 7.2. The harvested organisms are centrifuged and the supernatant discarded. A volume of sterile distilled water 10 times the wet weight of the sediment is added, the sediment is resuspended, and the mixture is allowed to stand at 5°C for at least 18 hours, with occasional shaking. The solid particles are then removed by centrifugation, and an equal volume of 1.7-percent saline is added. The antigen now constitutes approximately a 1/20 (weight/volume) dilution of the original parasite harvest but contains only the water-soluble components of the parasites. It is stored in the deepfreeze until it is used.

Sensitization of red cells with these antigens requires treatment of the red cells with 1/20,000 tannic acid. Sheep red cells have been used, and the techniques are like those used by Stavitsky (*6*). The red-cell concentration used was close to that recommended by Stavitsky. The density of the red-cell suspension was measured in each case by lysing 1 ml of the diluted cells with 5 ml of distilled water and measuring the optical density at 520 mμ in a Beckman spectrophotometer. It was found that the most usable concentrations gave readings varying from 0.4 to 0.6. A diffuse settling of cells is regarded as a 4+ reaction, whether or not any crinkling of the outer edges of the settled film occurs. The 2+ reaction of Stavitsky is the same as our 2+ reaction, and is taken as the endpoint, at which the titer of the test serum is measured.

Block tests have been performed to determine more closely the optimal concentrations of reagents to use in the hemagglutination test. In general, the results indicate that an antigen concentration of 1/200 and a red-cell suspension giving an optical density reading of 0.4, as described, gave the highest titers with the test serums, with adequate negative controls. A reading of 0.4 is obtained with a suspension of 2.0 to 2.5 percent red cells, depending on length of storage. It appears also that antigens vary in their initial potency, and each one must be adjusted for optimal concentration prior to use.

Table 1. Agreement between dye-test titers and hemagglutination titers in tests with different lots of erythrocyte-sensitizing antigens.

Dye-test titer	No. of tests	Hemagglutination tests on same serums agreeing within	
		2-fold difference	4-fold difference
1/16	11	7	11
1/64	12	9	12
1/256	9	7	9
1/1024	10*	4	6

* All tests agreed within an eightfold difference.

About 15 *Toxoplasma* antigens have been tested by this procedure, using a variety of human serums, either pooled or individual specimens, with different dye-test titers. Not all antigens have been used with the same serums. Good agreement has been found between dye-test titers and hemagglutinating titers, as seen in Table 1. Fourfold differences in titer can frequently be found in different dye tests on the same serums. Therefore, the hemagglutination test agrees as well with the dye test as can be expected. The hemagglutination reaction, in tests on serums from one proved human case of lymphadenopathic toxoplasmosis, became positive slightly later than the dye test, but much earlier than the complement-fixation test.

Results thus far obtained in more than 100 tests similar to those described in Table 1, but using pooled lots of antigen, continue to show excellent agreement between the hemagglutination and dye tests. All except one serum found positive with the dye test have been positive also by hemagglutination. Agreement between the tests within a four-fold difference in titer has been obtained with 93 percent of the specimens. With only 4 percent of the serums was the disagreement in titer greater than 16-fold. All of this work has been done with human serums. While additional problems may be encountered with animal serums, it seems justifiable to conclude that the hemagglutination reaction offers promise of providing a practicable serological procedure for the diagnosis of toxoplasmosis.

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14 February 1957

Effects of Penetrating Brain Injury on Intelligence Test Scores

Despite centuries of interest in the effect of cerebral lesions on intellectual function, there is no agreement on the localization of those injuries which might produce maximal deficit on tests of "general intelligence." One might suspect that any brain injury of sufficient size produces lasting deficits, in analogy to Lashley's results for rats (*1*). Against this view are recurrent claims that only lesions in certain areas of the brain, especially the frontal lobes, are followed by a loss (*2*). The uncertainty is increased by the large number of reports describing "negative" findings—that is, the absence of demonstrable deficits in test performance, despite the presence of large cerebral lesions, especially of the frontal lobes (*3, 4*).

Most information derives from the testing of patients (often past middle age) with brain tumors or vascular accidents, and from cases of lobotomy, or similar forms of psychosurgery in psychosis, severe neurosis, or intractable pain. Estimates of the decline of intelligence, based on comparison with premorbid scores (*4, 5*) are rendered doubtful by the extent to which the disease process (brain tumor or psychosis) might have affected the patient's performance before operation or continued to affect it afterward. As a result, the information is usually based on abnormal preas well as postoperative scores.

To our knowledge, no studies exist which compare scores obtained on a standardized test of intelligence by patients after stable, localized brain injury, with corresponding scores achieved before injury, and at a time when the patient could be considered physically and mentally intact. Nor are there studies in which a sufficiently long period elapsed after injury to allow maximum recovery from the effects of the brain wounds.

The opportunity for such a study arose in the course of a research program evaluating the effects of penetrating brain wounds on various aspects of behavior. We were able to obtain preinjury scores on the Army General Classification Test (AGCT), a standardized test of "general intelligence" given each man on induction into the armed services, for 62 men who subsequently sustained penetrating brain wounds, and for 50 controls —men who subsequently incurred peripheral nerve injuries of the arm or leg. All men had been injured in World War II, 1 to 3 years after the initial testing.

Approximately 10 years after they had been wounded, these men were retested in our laboratory with a comparable form of the AGCT (First Civilian Edition). Since all men had been given thorough physical and at least cursory psychiatric examinations prior to induction, their preinjury scores can be considered as reasonably accurate estimates of intellectual capacity within the limits of such tests. Localization of the brain wound was based on surgeons' notes at initial *debridement*, subsequent craniotomy, and on roentgenographic evidence—that is, bone defect and retained foreign bodies. In view of the lack of histologic verification of the lesion, all localizations are considered tentative.

The preinjury scores of our control and brain-injured groups were practically identical: the mean of the controls was 106.4, that of the subsequently brain-injured group was 105.0. On the postinjury test, 48 of the 50 controls increased their score, yielding a mean of 119.4, or a mean increase of 13.0 points. This general tendency to gain was an orderly phenomenon, since the correlation (Pearson r) between pre- and postinjury scores was .902, indicating considerable retest reliability.

The 62 brain-injured men were subdivided into groups according to the estimated location of their lesions (frontal, temporal, parietal, occipital, in left, right, or both hemispheres), and the data were subjected to a series of analyses of variance. These analyses demonstrated that lesions of the frontal and occipital lobes did not produce a significant decline in score, and that only groups with lesions of parietal or temporal lobes of the left hemisphere showed a significant decrease. In order to investigate further the role of these regions, a subsequent analysis was performed which compared men with lesions involving either or both of these lobes with those in whom these lobes were spared (*6*). Figure 1 (black bars) shows that, although the group with lesion to the left temporal lobe showed a slight decrease in score, the most striking drop was exhibited by the group with left parietotemporal lesion. In comparison with the large gain shown by the control group, the group with left parietal lesion showed only a slight increase on retesting; the groups with lesions in left nonparietotemporal regions or lesions in the right hemisphere showed greater gains, closer to that of the control group.

One might suspect that the inferior performance of the groups with lesions to the left parietal and temporal lobes (either or both) was entirely due to the presence of aphasia. Indeed, when the analyses were restricted to nonaphasics (striped bars), the groups showed somewhat higher scores; and the group with left temporal lesions now exhibited a gain, rather than loss. The left parietotemporal group alone still showed a loss in score, illustrating the statistically significant inferiority of this group to all other groups.

The concentration in a particular area (left parietotemporal) of those lesions which, in the absence of aphasia, produced a demonstrable AGCT deficit, opposes the view that impairment is

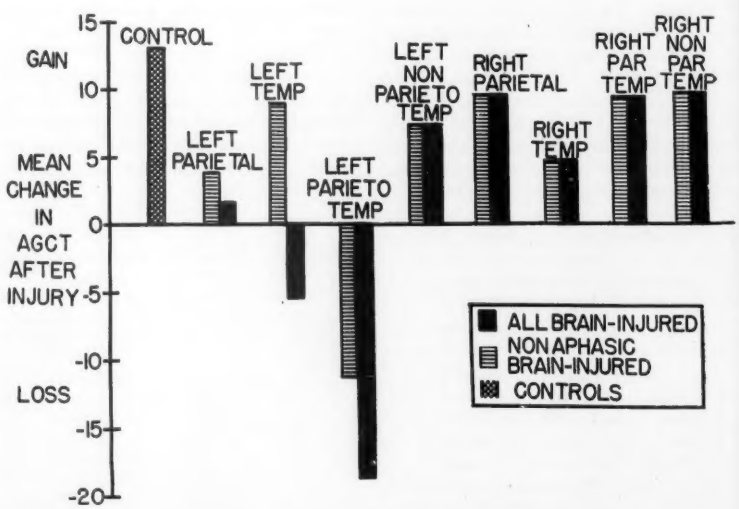

Fig. 1. Mean change in score from pre- to postinjury on Army General Classification Test for controls and for brain-injured subgroups, including and excluding aphasics. The median change and N (parenthetic) for the groups are as follows: Controls (50) 12.5; left temporal (4) −0.5; left parietal (11) 3.0; left parietotemporal (10) −10.0; left nonparietotemporal (9) 14.0; right temporal (9) −1.8; right parietal (7) 10.0; right parietotemporal (2) 9.5; and right nonparietotemporal (10) 12.0. The median change and N for the nonaphasic groups are as follows: left temporal (2) 9.0; left parietal (10) 4.0; and left parietotemporal (6) −9.0.

equal after lesions in any lobe (*1*) or that it should be maximal after injury to the frontal regions (*2*). There is, however, evidence that the present results are limited to the kind of test employed. Using the same population, we found that injury to any lobe of the brain, in either hemisphere, can interfere with performance on certain nonlanguage tasks such as the discovery of hidden figures (*7*).

Performance on a standardized test of "general intelligence," such as the AGCT, thus shows little or no change 10 years after penetrating brain wounds unless the entrance wound included the left parietotemporal region.

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4 March 1957

Radiocarbon Dates of Mankato Drift in Minnesota

The Mankato drift in Minnesota has recently been shown by Wright and Rubin (*1*), on the basis of radiocarbon dates, to be older than the Two Creeks forest bed in northeastern Wisconsin. In a paper (*2*) that was prepared and submitted for publication in June 1956 but which has just been issued, I reached the same conclusion for the Mankato drift of northern Lower Michigan. But Wright and Rubin *1*, p. 626 express the view that the Mankato drift "should be correlated with the Cary (pre-Two Creeks) rather than with the Valders (post-Two Creeks)." And they further state, "We therefore favor the use of the term *Valders* over the term *Mankato* for the last major substage of the Wisconsin." The question was not discussed that, even though the Mankato is older than Two Creeks, it might still be younger than the Cary, which I show in my article to be the case.

In northern Lower Michigan, as pointed out by Leverett long ago (*3*), the terminal moraine of the Mankato, the Port Huron, transects the last known interlobate deposits of the Lake Border system of late Cary age. Before it was built, the desiccation of the Cary ice had taken place. After a short intraglacial interval, the Cary-Mankato, the Mankato glacier formed from the renourished Patrician center and moved southward across the Straits of Mackinac to its terminal position (see *2*, Fig. 1). Leverett, the revered apostle of glacial-lobe deployment, pointed out that morainic systems which were built following marked readvances like the Port Huron system should be recognized as substages (*3*, p. 31). It is not a "recessional" of the Cary. Likewise, the red drift of the Valders is not a "recessional" of the Mankato.

In Minnesota a similar situation exists. Leverett's map (*4*, Plate 2) shows that immediately south of the Bigstone moraine in northwestern Minnesota, southeast of Ortonville, elongate ridges, resembling crevasse fillings, occur which are transected by the Bigstone moraine (Fig. 1), in the same way that the Port Huron moraine crosses the interlobate pattern of the Lake Border system, except that in Minnesota the transecting moraine is Valders and the deposits out in front are Mankato.

Upon searching for what Leverett might have said about this significant relationship, I find this (*4*, p. 105): "The morainic strips just mentioned [those out in front of the Bigstone moraine] seem to pertain to a very narrow ice tongue that was gradually reduced until it completely melted before the ice sheet readvanced with a broader front to a strong moraine that traverses southern Big Stone County and northwestern Swift County. . . . They complete the series which deployed in the basin drained by the Minnesota River and were followed by a series of moraines formed by an ice lobe that was confined mostly to the Red River Basin." Leverett recognized this as a younger and separate substage of the Wisconsin (*5*, Fig. 5).

Thus, it would appear that the retreat of the Mankato ice gave rise to Lake Agassiz I, that the Valders ice transgressed most if not all of the lake bed, and that the outlet waters of Lake Agassiz II, upon the retreat of the Valders ice from the Bigstone moraine, cut River Warren Valley II. This narrow gorgelike valley is clearly related to the marked change in topography brought about by the deposition of the Bigstone morainal system. As Leverett observed, it is in contrast to the much wider valley of River Warren Valley I, below the terminus of the moraine. Thus, the present beaches are younger than the Valders terminal moraine, although some of the recent topographic maps seem to show short stretches of slightly glacially modified beaches of Lake Agassiz I.

It is also interesting to note that the two valley-train terraces along the Mississippi River in western Illinois, which have been assigned to the early and late Mankato by Leighton and Willman, are but mere remnants of former fills, caused by two successive glacial torrents, the first greater than the second. The new facts throw interesting light on these interpretations. Leighton and Willman have consistently referred the destructive torrents which not only swept away most of the valley trains but sliced the bluffs and headland points in the Mississippi Valley, to the outlet waters of Lake Agassiz I and II and Lake Duluth. More recently Leighton has traced the upper and older terrace that is composed of coarser materials to the Mankato outwash to Dakota County, Minnesota, where it has been mapped as such by Ruhe and Gould (*6*). Now it appears that the lower terrace of finer materials may be Valders and may have come from the ice when it stood at the Bigstone moraine. The terrace at Bonfils, Missouri, across from St. Charles, which was formerly referred to the Mankato, is now known to be Tazewell, from two radiocarbon dates determined by the Washington laboratory. The Tazewell date is consistent with the fact that this terrace remnant has loess on its surface which is essentially lacking on Mankato or Valders terraces.

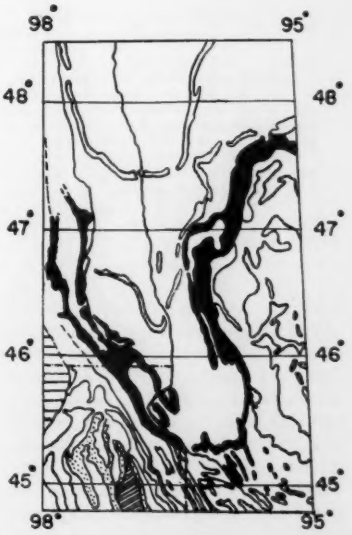

Fig. 1. Bigstone morainal system in the Red River basin, suggested as Valders. The outer portion of Valders is shown in black, Mankato open, Cary dotted, Tazewell diagonally lined, and glacial Lake Dakota horizontally lined [After Leverett (*4*, plate 3) and Flint (*8*)].

The radiocarbon dates that are cited by Wright and Rubin for the Grantsburg lobe of the Mankato (*1*, p. 625) are, it will be noted, rather young for the Cary and are what one might expect for the Mankato. A Washington date for Glenwood II beach of Lake Chicago which Bretz (*7*) refers to Lake Whittlesey and the culmination of the Port Huron ice is 12,200 ± 350 years (sample W-161).

The classification that I proposed in my recent paper (*2*, p. 109) after I had analyzed the Wisconsin-Michigan area seems perfectly applicable to the entire Mid-west. This classification divided the Wisconsin into the following substages: (i) Farmdale; (ii) Iowan; (iii) Tazewell; (iv) Cary; (v) Mankato; (vi) Valders.

The name of the intraglacial substage immediately preceding the Valders—Two Creeks—is well known and will be used as a matter of second nature, but for the others the compounding of the names will be adequate and appropriate until new information dictates otherwise (*9*).

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9. I gratefully acknowledge the support that I have received from the Illinois Geological Survey and the State Board of Natural Resources and Conservation as research professional scientist and from the U.S. Geological Survey as consultant in Midwest glacial geology. I also wish to state that the stratigraphic nomenclature used in this report does not necessarily conform with that used by the U.S. Geological Survey.

8 February 1957

M. M. Leighton has had the benefit of four decades of close attention to the problems of glacial stratigraphy of the Great Lakes region, and he is responsible for naming most of the subdivisions of the Wisconsin glacial stage in current use. His comments are therefore appreciated (*1*).

The history of the terminology is summarized in Fig. 1 (*2–12*). In brief, Leighton points out that Leverett's correlation (*2, 3, 4*) of the Port Huron moraine with the Mankato (Bemis moraine) of Minnesota has been vindicated by a combination of stratigraphic revisions in Michigan (*8*) and radiocarbon-based revisions in Minnesota (*9, 10*), and that the term *Mankato* should be retained as a post-Cary, pre-Two Creeks substage of the Wisconsin. He thus implies that the Two Creeks interstadial had been inserted into the Wisconsin classification at the wrong position—that is, below Mankato rather than above—because the Mankato equivalent had not at that time been identified in northeastern Wisconsin.

The problem of whether to consider the Port Huron moraine and the Mankato of the Des Moines lobe of Minnesota as representatives of a separate substage or as a late phase of the Cary depends on the magnitude of the warm interval and the accompanying ice recession that followed the Cary maximum and preceded the Mankato-Port Huron phase in question. Leighton (*12*) considers that the Cary ice withdrew north of the Straits of Mackinac during this interval before it readvanced to the Port Huron moraine in the Mankato with a somewhat different alignment. Bretz (*8*), however, mentions no evidence in the strand-line record of glacial Lake Chicago for a pre-Port Huron retreat and low-water level of this magnitude. Inasmuch as no buried soils or forest beds record the suggested interstadial in this region, the evidence for appreciable retreat of the Lake Michigan lobe prior to readvance is limited to the truncation of the Lake Border moraine by the massive Port Huron moraine. It might be admitted that such truncation is the basis for distinguishing Cary from Tazewell moraines in Illinois, but truncation of equal magnitude may be found for moraines within a single substage (as Bloomington versus Shelbyville moraines of the Tazewell).

Actually, the evidence for separating Mankato from Cary is stronger in Minnesota than it is in Michigan. The Superior lobe retreated at least 120 miles from its Cary terminus at the St. Croix moraine, so that its melt-water drainage channels were completely abandoned before the Mankato ice of the Des Moines lobe advanced from the west for 75 miles over the bared area (*13*). Although two ice lobes of diverse source are involved here, a significant climatic amelioration is suggested for the interval between the Cary and Mankato by these relations in Minnesota. This interval had been assumed to be the Two Creeks interstadial until it was found (*9*) that the retreatal deposits of the upper drift (Mankato) had a carbon-14 age of 11,000 to 13,000 years.

To date, no weathering horizon or buried forest bed has been identified from this stratigraphic position. The closest candidate is the wood found in outwash between two tills in the Lizard Creek section near Fort Dodge on the Des Moines River in central Iowa; the tills were interpreted as Cary and Mankato by Ruhe and Scholtes, and two samples of the wood (hemlock) were dated by radiocarbon analysis as 13,300 and 12,120 years old (*10, 14*).

I have previously agreed (*10*) with

<table>
<tr><th>Leverett 1915, 1929 1932 (2,3,4)</th><th>Leighton 1933 (5)</th><th>Thwaites 1943,1946 (6,7)</th><th>Bretz 1951 (8)</th><th>Wright & Rubin 1956; Zumberge & Wright 1956 (9,10)</th><th>Leighton 1956,1957 (11,12)</th><th>Wright 1957</th></tr>
<tr><td rowspan="2">LATE: 5th–Big Stone moraine 4th–Pt. Huron; Bemis; red till NE. Wis.</td><td rowspan="2">MANKATO</td><td rowspan="2">5th–MANKATO (or=Valders) 4th–VALDERS (red till NE. Wis.)</td><td rowspan="2">VALDERS</td><td rowspan="2">VALDERS</td><td>VALDERS (Big Stone mor.)</td><td>VALDERS (Lake Agassiz)</td></tr>
<tr><td>TWO CREEKS (L. Agassiz I)</td><td>TWO CREEKS (L. Agassiz)</td></tr>
<tr><td>INTERSTADIAL</td><td>INTERST.</td><td>TWO CREEKS</td><td>TWO CREEKS</td><td>TWO CREEKS</td><td>MANKATO (Pt. Huron; Altamont mor.)</td><td rowspan="2">MANKATO (Big Stone, Altamont; Mille Lacs, Highland; Port Huron moraines)</td></tr>
<tr><td rowspan="3">MIDDLE: 3rd–Kalamazoo mor.</td><td rowspan="3">CARY</td><td rowspan="3">3rd–CARY</td><td rowspan="3">CARY: Pt. Huron; L. Border & older mor.</td><td rowspan="3">CARY: Late (=Mankato); Maximum</td><td>INTERSTADIAL</td></tr>
<tr><td>CARY (Lake Border & older moraines)</td><td>CARY (Bemis; St. Croix; Lake Border & older mor.)</td></tr>
<tr><td>INTERST.</td><td>INTERST.</td><td></td><td></td><td></td><td>INTERSTADIAL</td><td></td></tr>
<tr><td>EARLY: 2nd–Bloomington mor. 1st–Shelbyville</td><td>TAZEWELL</td><td>2nd–TAZEWELL</td><td></td><td></td><td>TAZEWELL</td><td></td></tr>
<tr><td rowspan="4">PEORIAN INTERGL.</td><td>INTERST.</td><td></td><td></td><td></td><td>INTERSTADIAL</td><td></td></tr>
<tr><td>IOWAN</td><td>1st–IOWAN</td><td></td><td></td><td>IOWAN</td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td>INTERSTADIAL</td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td>FARMDALE</td><td></td></tr>
<tr><td>IOWAN</td><td>SANGAMON INTERGL.</td><td>SANGAMON INTERGLACIAL</td><td></td><td></td><td>SANGAMON INTERGLACIAL</td><td></td></tr>
<tr><td>SANGAMON INTERGL.</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

Fig. 1. History of classification of Wisconsin glacial stage in the Great Lakes region.

Leighton that the Mankato drift of southern Minnesota is probably correlative with the Port Huron moraine of Michigan, and, pending further field studies and radiocarbon dates of pertinent deposits, will yield to Leighton's proposal that the term *Mankato* be retained as a substage of the Wisconsin, in its new pre-Two Creeks position.

Leighton's suggestion that the Valders border of the Des Moines lobe lies at the Big Stone moraine represents a modification of a much earlier suggestion of Leverett (Fig. 1), who at one time designated this moraine as marking the fifth substage of the Wisconsin (*3*, Fig. 5). The suggestion has renewed appeal as one casts about for a Valders terminus north of the Mankato region.

The Big Stone moraine across the Minnesota River valley sharply truncates elongate ridges that Leverett implied were lateral moraines of the shrunken Des Moines lobe of the fourth substage. Leighton interprets these ridges instead as crevasse fillings; he likens the relations to the transection of the Lake Border interlobate moraine (Cary) in Michigan by the Port Huron moraine (Mankato), and considers that in both areas the intervening retreat should be of interstadial rank. Retreat of Mankato ice into the Red River valley during the Two Creeks interstadial, in this view, would allow the formation of Lake Agassiz I, with a broad southern outlet via River Warren I (Minnesota Valley). Valders readvance to the Big Stone moraine would be followed in turn by final retreat and the formation of Lake Agassiz II.

The elongate ridges in question are composed of clay till (*4*, p. 105). Aerial photographs suggest that they are neither lateral moraines nor crevasse fillings, but are erosional remnants of the Mankato till plain separated from one another by multiple drainageways funneling broadly from the Big Stone moraine into the center of the Minnesota Valley. The moraine was later cut by the River Warren drainage of Lake Agassiz.

With this interpretation, the necessity for inferring a distant withdrawal of the Des Moines lobe before readvance to the Big Stone moraine is reduced. The only reports of overridden lake beds in the Agassiz area refer to a much earlier lake (C^{14} dated as $> 36{,}000$ years old, Bronson, samples W-102 and W-468). At any rate, correlation of the Big Stone moraine with the Valders does not help with the problem in question because the C^{14} dates for undisturbed Lake Agassiz beds in Minnesota and southern Manitoba are mostly of Two Creeks age or older (*9*), and the Valders drift border must therefore be north of the radiocarbon sites.

Elson (*15*) postulated a Valders ice front extending from the Lake Winnipeg region eastward to Lake Superior and thence south to the Michigan Upper Peninsula and the Valders type area. This line circumvents Minnesota completely and denies the identification of Valders drift of the Superior lobe in northeastern Minnesota, which I (*16*) had made on the basis of lithologic and stratigraphic similarity to the Valders of northeastern Wisconsin. My Superior-lobe Valders in Minnesota had met with some radiocarbon difficulties, however: on the basis of interbedding it was considered to have formed contemporaneously with drift of the St. Louis sublobe (of the Des Moines lobe), which had its origin in the Red River valley in the very area where undisturbed Lake Agassiz sediments gave pre-Valders C^{14} dates. A new date (*17*) pertinent to this specific problem comes from glacial Lake Aitkin, a feature formed during the retreat of this St. Louis lobe and the presumed Valders Superior lobe. This date of $11{,}710 \pm 325$ years before the present (sample W-502) seems to be too old for late Valders, and fits the pattern of Two Creeks or "late Mankato" dates for the Anoka sand plain (Grantsburg sublobe of Des Moines lobe) and Lake Agassiz. If Elson's or some other northern Valders line is confirmed by additional work, the red clay till of northeastern Minnesota must reflect some pre-Two Creeks readvance of the Superior lobe. Two earlier Superior-lobe advances have been described (*13*), one as far as the St. Croix moraine (Cary maximum), a later one to the Mille Lacs and Highland moraines (Mankato?).

Despite the uncertainties of the correlations from lobe to lobe, the evidence from Lake Huron to the Dakotas, however, seems today to support the view that an important readvance of several ice lobes occurred just prior to the Two Creeks interstadial. Although I have previously suggested that this readvance be included as a late phase of the Cary, following Bretz, I am willing to apply to it the term *Mankato*, following Leighton, with the hope that correlation of the Mankato drift of the Des Moines lobe with the Port Huron of the Lake Michigan and Huron lobes will be more strongly confirmed.

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References and Notes

1. I am obliged to my coauthors of earlier discussions of this problem, Meyer Rubin of the U.S. Geological Survey and J. H. Zumberge of the University of Michigan, for reading this further discussion. I also appreciate the many keen comments offered by Leighton and many other participants in the 1956 Glacial Field Trip of the Geological Society of America, during which much of the field evidence bearing on the Cary-Mankato-Valders problem in eastern Minnesota was reviewed.
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4 April 1957

Dependence of Acute Radiosensitivity on Age in Adult Female Mouse

The literature on radiation sensitivity of animals at advanced ages is not extensive. Zirkle *et al.* (*1*) determined the LD_{50} for x-rays in the mouse as a function of age for ages ranging from 1.5 to 12 months. Hursh and Casarett (*2*) reported LD_{50}'s for rats at ages of 6 and 16 months. Kohn and Kallman (*3*) made a careful determination of the LD_{50} for single doses of x-rays for ages ranging from 40 to 640 days. Several studies have been made of age changes in sensitivity during the period of postnatal growth (*4*).

The paucity of information about acute lethality at advanced ages may be the result, in part, of the cost of such measurements when the conventional method of plotting a dosage-survival curve is employed. An effort was therefore made to develop a more efficient and less costly method of measuring the acute lethal action of ionizing radiation (*5*).

It was found, previously, that the mean accumulated dose that is required to determine a mean survival time of about 30 days (MAD/30 days) under a regime of daily exposure is correlated with the LD_{50}/30 days (*6*). This observation was based on interspecies comparison, but a high correlation has since been observed between these two measures for several mouse genotypes (*7*). A pilot study of age-dependence in acute radiosensitivity was therefore carried on, by use of the mean accumulated dose procedure.

Carworth female mice received at this laboratory at from 5 to 6 weeks of age were caged in groups of ten (11 in one

case), in 8- by 8- by 8-inch wire-mesh cages (*8*). The cage groups were maintained in the animal colony until they had reached assigned test ages, when they were exposed to 100 r of x-radiation per day, 5 days per week, for the duration of life. The cages were transported to the x-ray cubicle and were irradiated; the mice that they contained were in a vertical x-ray beam that delivered about 15 r/min 0.5 inch above the cage floor. Dose rates were measured with Victoreen condenser chambers. Radiation factors were: 200 kvp (peak) at 15 ma from a half-wave generator; 0.5 mm Cu and 1.0 mm Al added filtration; half-valve layer, 0.9 mm Cu.

The distributions of survival times after the beginning of treatment are given in Table 1. Mean after survivals (MAS), their standard error (SE), the standard deviations of the survival curves (SD), and the mean accumulated doses (MAD) are also given.

In the period from 100 to 600 days of age, the mean accumulated dose shows comparatively little dependence on age, but in the period from 600 to 800 days of age, it decreases rapidly.

The results found here are in fairly good accord with those of two LD_{50} studies that covered the same age ranges. Zirkle *et al.* (*1*) and Kohn and Kallman (*3*) found little change in LD_{50} in the first year, and Hursh and Casarett (*2*) found LD_{50}'s of 715 r for 6-month-old, and 600 r for 16-month-old, rats. Studies currently under way indicate that in mice there is a small but significant increase in LD_{50}/30 days and MAD/30 days during the period from 100 to 400 days of age (*9*). All of these data are consistent in indicating that the change of radiosensitivity with age is small during the first half of the adult life span.

The dependence of radiosensitivity on age in the later part of the life span has not been reported previously. The data presented here indicate that sensitivity increases rapidly with age in this period. Although the samples available for test at advanced ages were small, the downward trend observed at ages greater than 600 days is highly significant. This is confirmed by current studies (*9*).

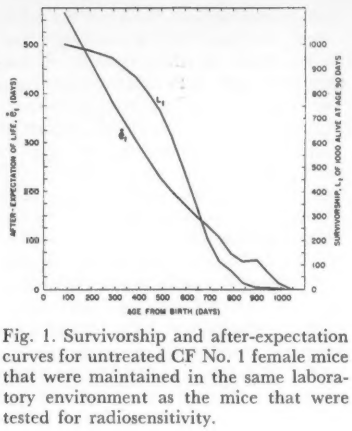
AFTER-EXPECTATION OF LIFE, $\mathring{e}_t$ (DAYS)
SURVIVORSHIP, l_t, OF 1000 ALIVE AT AGE 90 DAYS
AGE FROM BIRTH (DAYS)
l_t
$\mathring{e}_t$

Fig. 1. Survivorship and after-expectation curves for untreated CF No. 1 female mice that were maintained in the same laboratory environment as the mice that were tested for radiosensitivity.

The survivorship curve and the after-expectation of life curve for untreated CF No. 1 female mice is given in Fig. 1. These curves are based on a large sample of mice that were maintained in the same laboratory environment contemporaneously with the mice that were tested for radiosensitivity.

One of the reasons for making this study on the age-dependence of radiosensitivity was to test the adequacy of a set of postulates about the lethal action of ionizing radiations. In brief, the postulates specified that injury is proportional to dose, that recovery is proportional to amount of injury, that all kinds of radiation injury sum with the effects of age, and that injury due to aging accumulates as a linear function of age. These postulates had been enunciated by me (*8*) and, in a basically similar form, by Blair (*10*). An important deduction was that the curve of LD_{50} versus age should have approximately the form of the curve of after-expectation of life; that is, it should be approximately linear during the first half of life and concave upward throughout adult life. The curve of mean accumulated dose versus age (Table 1) departs markedly from this form. In view of the available data on LD_{50} versus age, and of the form of the radiosensitivity curve found in this study, it is concluded that one or more of the postulates referred to in the first part of this paragraph must be revised (*11*).

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Table 1. Survival times of CF No. 1 female mice exposed to 100 r 5 days per week, mean after-survival times (MAS), standard errors of means (SE), standard deviations of survival times (SD), and mean accumulated dose (MAD). Day 0 was the day of first exposure.

Age at exposure (day)	Survival time (day)											*n*	MAS	SE	SD	MAD
95	16	18	21	21	23	25	26	28	29	30	36	11	24.8	1.8	5.8	1827
151	24	31	32	35	36	36	37	38	39	41		10	34.9	1.6	4.9	2560
263	13	21	27	28	36	37	38	38	38	41		10	31.7	2.9	9.1	2320
375	14	25	32	36	38	44	44	49				8	35.3	4.1	11.5	2562
375	18	31	33	36	36	36	38	39	42	48		10	35.7	2.5	7.8	2620
487	18	32	32	34								4	29.0	3.7	7.4	2175
543	24	28	29	30	32	35	46					7	32.0	2.5	6.6	2329
599	15	16	23	32	35	41						6	27.0	4.3	10.6	1983
599	27	32	33									3	30.7	1.9	3.2	2300
711	4	18	28									3	16.7	6.9	12.0	1267
711	16											1	16.0			1200
823	3	6										2	4.5			400

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18 February 1957

Oxidation of Chlorpromazine by Peroxidase and Catalase

The *in vivo* and *in vitro* conversions of chlorpromazine to its sulfoxide have been observed (*1, 2*). The mechanism of oxidation has not been described. This report is concerned with the oxidation of the drug by hydrogen peroxide in the presence of the enzymes peroxidase and catalase. Peroxide oxidation of phenothiazines generally has long been known (*3*); however, under the conditions prevailing in biological systems, the uncatalyzed peroxidation is sluggish.

It was found that in the range *p*H 3 to 6.3 chlorpromazine was readily converted to a deep red substance by hydrogen peroxide and peroxidase. A similar result was obtained with catalase over a more restricted *p*H range, no color appearing above *p*H 4.5. In both cases, the solutions bleached at rates dependent on the relative concentrations of the reagents. Both the extent of color production and the rate of bleaching

were appreciably lower in the presence of catalase than they were when peroxidase was used. At very low peroxide concentrations and fairly high chlorpromazine concentration, the bleaching was retarded, and the absorption spectrum of the red material could be examined (Fig. 1*A*). When bleaching was complete, the ultraviolet absorption spectra of the enzymic reaction mixture, chlorpromazine, and chlorpromazine sulfoxide were compared. The spectral comparison (Fig. 1*B*) indicates that the sulfoxide was probably present in the product mixture.

Descending paper chromatograms were developed with the solvent mixture recommended by Salzman and Brodie (*2*). Aliquots of the enzymic reaction mixture were taken at several intervals after the reaction was started. Within 10 minutes, a spot identified as that of the sulfoxide was detectable, and within 30 minutes the sulfoxide spot was strongly colored, while the chlorpromazine spot showed a greatly reduced color intensity. Sampling of the completely bleached reaction mixture several hours later resulted in the appearance of a very strong sulfoxide spot. In no case did more than two spots appear. Either the red product was not detectable with the sulfuric acid spray, or its migration was identical with that of chlorpromazine. Catalase oxidation produced the same result, giving spots having R_f values of 0.82 to 0.84 and 0.93 to 0.96. Control R_f values for the sulfoxide and chlorpromazine run under the same conditions were, respectively, 0.77 to 0.86 (0.82 average) and 0.89 to 0.97 (0.93 average).

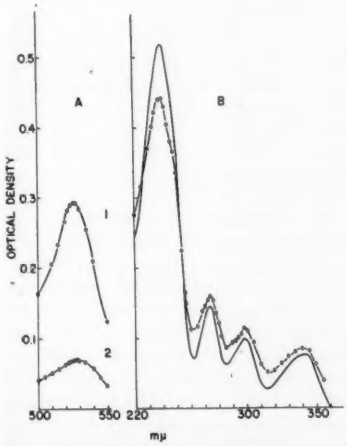

Fig. 1. Absorption spectra of enzymic oxidation products. (*A*) Curve 1: H_2O_2 ($1.7 \times 10^{-5}M$), chlorpromazine hydrochloride ($9.2 \times 10^{-4}M$), and horse radish peroxidase (Worthington; 1.3 μg/ml) in $0.1M$ acetate buffer at *p*H 4.5. Curve 2: H_2O_2 and chlorpromazine as for curve 1 and crystalline beef liver catalase (Worthington; 13 μg/ml) in $0.06M$ acetate buffer at *p*H 4.5. The blanks contained all components except H_2O_2. (*B*) Solid line: chlorpromazine sulfoxide ($10^{-5}M$). Curve showing experimental points: the initial reaction mixture contained chlorpromazine · HCl ($1.6 \times 10^{-4}M$), H_2O_2 ($3.8 \times 10^{-5}M$), and peroxidase (3 μg/ml) in $0.06M$ acetate buffer at *p*H 5.5. After 30 minutes, a sample was diluted 1/15 with buffer for spectrophotometry. Both curves represent measurements made in the same buffer. The blanks contained all components except chlorpromazine.

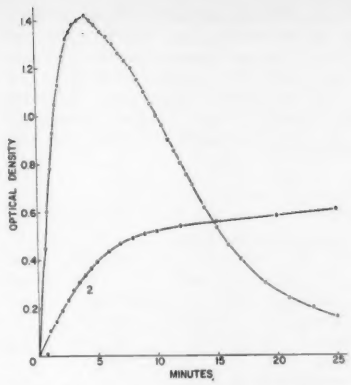

Fig. 2. Time courses of formation and decay of enzymic oxidation products. Curve 1: red intermediate; chlorpromazine · HCl ($9.7 \times 10^{-4}M$), H_2O_2 ($1.76 \times 10^{-4}M$), and peroxidase (2.3 μg/ml) in $0.1M$ acetate at *p*H 4.5. Measurement was made with the photomultiplier attachment at 527 mμ, slit 0.09 mm, and approximately 25°C. The blank contained all components except the enzyme. Curve 2: same conditions as in curve 1 except that chlorpromazine and enzyme concentrations were reduced to $9.7 \times 10^{-6}M$ and 0.23 μg/ml, respectively. Measurements were made at 274 mμ, slit 2.1 mm, no photomultiplication. The blank contained all components except the enzyme.

A qualitative indication of the time-courses of formation and decay of the red product and the formation of the sulfoxide was obtained by following absorbancy changes at 527 and 274 mμ (Fig. 2). The rapidity of the former reaction and the relative slowness of the latter suggested that the red product was a precursor of the sulfoxide. Since the blank cuvettes in these experiments contained all components except the enzyme, compensation for any nonenzymic peroxidation was made automatically. Indeed, no slit adjustment was necessary during either experiment, and it was concluded that no measurable uncatalyzed oxidation had occurred. It has been shown *in vivo* (*2*) that the sulfoxide itself undergoes further metabolism. Since the systems described here yielded the sulfoxide as the terminal product, it was clear that, at best, these oxidations could not account for any steps beyond sulfoxide formation in the over-all metabolism.

The metabolic significance of catalase and peroxidase is not entirely clear, nor is it certain that mammalian peroxidases would carry out the reactions described here for the horse radish enzyme. It is doubtful that these reactions represent more than interesting models of the actual mammalian oxidations. It is of interest that Tauber (*4*) has also shown that crystalline catalase is capable of oxidizing various large molecules.

It may be noted that, in tissues that are capable of generating respective amounts of hydrogen peroxide metabolically, the possible effects of catalase or peroxidases (even free hemoglobin) would be difficult to eliminate in studies on phenothiazine oxidation (*5*).

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5. Chlorpromazine hydrochloride (Thorazine) and chlorpromazine sulfoxide were generously supplied by the Smith, Kline and French Laboratories, Philadelphia, Pa.

25 February 1957

Sphingosine as an Inhibitor of Blood Clotting

One of us has isolated from brain tissue a powerful clot-delaying substance which has been identified as sphingosine (*1, 2*). This substance is a component of cerebrosides and sphingomyelins, but it is also found free as a contaminant in preparations of the latter, thus acounting for their inhibitory effect in blood clotting (*2*). Pure sphingomyelin is indifferent in blood-clotting reactions.

Sphingosine has also been isolated from the lipid activator of pig brain (*3*), and it seems to be the active principle of antithromboplastin (also called anticephalin) (*4*). According to Tocantins and Carroll (*5*), antithromboplastin appears in the blood of hemophiliacs in abnormally high quantities. With sphingosine and chicken plasma, interesting reactions are observed. With small quantities, clotting times are prolonged to 40 hours or more. However, in the presence of the lipid activator from pig brain, the inhibitory effect of sphingosine is abolished, and the clotting times may even be shorter than those obtained with optimal concentrations of the lipid activator alone. This may be called "sphin-

Table 1. Compensation and incubation effect with physiological and synthetic sphingosine. The composition of the reaction mixtures was as follows: lipid activator, 30 mm³ (6 mg/1 ml of 0.85-percent NaCl); plasma, 150 mm³; natural sphingosine, 30 or 60 mm³ (5 mg/1 ml of H_2O); synthetic sphingosine, 30 or 60 mm³ (1, 25 mg/1 ml of H_2O); all volumes were made up to 270 mm³ with either H_2O or NaCl (0.85 percent) as needed to obtain equivalent amounts of each in the final reaction mixture. Chicken plasma obtained from the carotid (method of Carrel) was used throughout. Clotting time was assayed by the method of Hecht (*7*).

Expt. No.	Composition of reaction mixture	Clotting time
1	Physiological NaCl solution + plasma	30 min, 0 sec
2	Lipid activator (30 mm³) + plasma	4 min, 50 sec
3a	Physiological sphingosine (30 mm³) + plasma	> 40 hr
	Physiological sphingosine (60 mm³) + plasma	> 40 hr
3b	Synthetic sphingosine (30 mm³) + plasma	> 40 hr
	Synthetic sphingosine (60 mm³) + plasma	> 40 hr
4a	Physiological sphingosine (30 mm³) + plasma + lipid activator directly	5 min, 0 sec
	Physiological sphingosine (60 mm³) + plasma + lipid activator directly	15 min, 15 sec
4b	Synthetic sphingosine (30 mm³) + plasma + lipid activator directly	4 min, 20 sec
	Synthetic sphingosine (60 mm³) + plasma + lipid activator directly	6 min, 10 sec
5a	Physiological sphingosine (30 mm³) + plasma + lipid activator added after incubation for 1 hr at 39°C	1 min, 8 sec
	Physiological sphingosine (60 mm³) + plasma + lipid activator added after incubation for 1 hr at 39°C	1 min, 25 sec
5b	Synthetic sphingosine (30 mm³) + plasma + lipid activator added after incubation for 1 hr at 39°C	43 sec
	Synthetic sphingosine (60 mm³) + plasma + lipid activator added after incubation for 1 hr at 39°C	58 sec

gosine compensation." If the chicken plasma is first incubated for 1 hour at 39°C with sphingosine, the clotting times with the lipid activator are one-third to one-sixth of those obtained with the optimal concentration of the lipid activator alone. This is called "incubation effect." This effect is not seen if the plasma is added to the incubated mixture of sphingosine and the lipid activator (*2*). Therefore we assume the presence of an unidentified component in the plasma which reacts with the inhibitor to produce the incubation effect.

Fortunately, sphingosine and certain derivatives have been synthesized (*6*). The structure of sphingosine is as follows: $CH_3—(CH_2)_{12}—CH=CH—CH(OH)—CHNH_2—CH_2OH$. DL-sphingosine has been studied in connection with chicken plasma, and all the reactions that occur with the use of concentrates from biological sources are seen with the synthetic preparation. However, smaller quantities suffice.

The intensity of the reactions with sphingosine depends largely on its concentration, on the concentration of the lipid activator, and on individual properties of the plasma. Synthetic *erythro*- and *threo*-dihydrosphingosine are weak inhibitors and give only a slight sphingosine compensation. Both substances may prolong slightly the clotting time of chicken plasma. They raise the activity of the lipid activator to a slight degree and, when incubated with plasma, produce very short clotting times. N-benzoyldihydrosphingosine is completely inactive, as is also the tri-acetyl derivative of sphingosine.

Our experiments give the information that the presence of the double bond, as well as the presence of the free functional hydroxyl and the amino groups, is essential for the clot-delaying activity.

We were also able to synthesize the two isomers of threoninol, which are the lowest homologs of dihydrosphingosine and which have the following structure; $CH_3—CHOH—CHNH_2—CH_2OH$. The free threoninols are indifferent in every respect. Their oxalates have a powerful inhibitory influence on the clotting of chicken plasma. This can be abolished by the lipid activator, but not after preliminary incubation of the oxalates with the plasma. Table 1 summarizes the clotting times of chicken plasma that has been treated with natural and synthetic sphingosine only.

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14 January 1957

Reaction of 8-Quinolinol and 2-Methyl-8-Quinolinol with Rare-Earth Elements

In an attempt to improve the selectivity of 8-quinolinol as an analytic precipitant, various substituted compounds have been proposed. Merritt and Walker (*1*) found that 2-methyl-8-quinolinol did not precipitate aluminum ion; thus it offered some selectivity over 8-quinolinol. Irving, Butler, and Ring (*2*) showed that this increased selectivity was the result of the steric hindrance effect of the methyl group at the 2-position. This effect would also slightly alter the sensitivity of the reaction of this reagent with other metal ions.

From the results of this previous work, one would predict that 2-methyl-8-quinolinol would perhaps be less sensitive in the detection of the trivalent rare earth metal ions than 8-quinolinol. Under the same conditions of hydrogen-ion and chelating-agent concentrations, this has been found to be true.

To determine the sensitivity of the chelating agents, a modification of the Irving, Butler, and Ring (*2*) method was used. An NH_4Cl-NH_4OH buffer was used because, with the buffers recommended in the original method, only 8-quinolinol gave precipitates with the metal ions (*p*H 8.4). The new buffer consisted of 100 g of NH_4Cl, 60 ml of concentrated NH_4OH, and 440 ml of water. The *p*H of a solution containing 2 ml of this buffer in a total volume of 6.2 ml was 9.5. Concentrations of the rare-earth chloride solutions were 0.01 and 0.001*M*. The chelating agents were 0.1*M* in 95-percent ethanol. Test solutions were heated 10 minutes at 70°C, then after they had cooled to room temperature, they were observed visually for signs of a precipitate.

The results of the sensitivity tests are given in Table 1. The concentrations of metal ions are expressed in micrograms of M^{+3} per milliliter. It can readily be seen that under the same conditions, the sensitivity of 2-methyl-8-quinolinol in precipitating the rare-earth metal ions is much less than that of 8-quinolinol. Quantitatively, the former chelating agent averaged about one-eighteenth as sensitive as the latter.

Table 1. Results of sensitivity tests.

Metal ion	8-Quinolinol	2-Methyl-8-quinolinol
Lanthanum	0.91	36
Cerium	0.93	18
Praseodymium	3.7	37
Neodymium	3.7	37
Samarium	1.9	39
Gadolinium	1.0	6.0
Yttrium	0.57	23
Scandium	1.2	2.9

The theoretical basis for sensitivity tests has been discussed by Irving and Rossotti (*3*). Although quite complex, the sensitivity of a precipitation reaction depends on the intrinsic solubility of the chelate and also the stability of the metal chelate. The intrinsic solubility of the chelate, in turn, is subject to the structural factors of the chelating agent. Since the introduction of a methyl group on the 8-quinolinol molecule should not alter the solubility of the metal chelates appreciably, the main factor here must be the stability of the chelate. Further work is needed to evaluate the stability constants of these chelates.

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4 March 1957

First Example of Genotype $r^y r^y$—a Family Study

In 1954 blood of a D-negative patient (F.S.) was submitted with a history of hemolytic disease of the newborn. The patient—the propositus—had two normal children followed by two infants with severe hemolytic disease. The infant born in 1952 died from kernicterus at 72 hours, while the infant born in 1954 recovered following numerous small transfusions. The serum of the propositus, when tested during the fourth pregnancy, contained anti-D (anti-Rh_0) to a titer of 1/128.

The blood of the propositus, II-2 in Fig. 1, failed to react with anti-D serums, but it reacted with anti-C and anti-E serums. The absence of reactions with several different anti-c and anti-e serums suggested that the gentoype of the propositus was $r^y r^y$ (*dCE/dCE*). The negative reactions for D^u and the production of anti-D further confirmed that the patient was D-negative. Because genotype $r^y r^y$ (*dCE/dCE*) had never been observed previously (*1*) studies were carried out with all available members of three generations shown in Fig. 1.

Only nine of the 12 members were available for testing, and a summary of the findings is presented in Table 1. The reactions were confirmed in tests with numerous examples of anti-D, anti-E, and anti-c and fewer samples of anti-C and anti-e. For the blood of the propositus, II-2, the following reagents were employed: 10 anti-D saline (complete) agglutinins, 16 anti-D albumin (incomplete) agglutinins, 11 anti-C, 12 anti-E, 8 anti-c, and 6 anti-e serums. Each of the 16 albumin (incomplete) agglutinins failed to react with the blood of the propositus both in the direct tests and in the antiglobulin test. These negative reactions further established the absence of the weakly reacting D^u in the blood of the propositus. Similarly, the absence of factors c and e was definitely proved by negative direct and indirect antiglobulin reactions.

From the data in Table 1, shown also in Fig. 1, it is noted that, excluding the husband of the propositus, there are seven members whose blood contains the very rare chromosome r^y (*dCE*)—the propositus who is $r^y r^y$ (*dCE/dCE*) and six who are heterozygous for r^y (*dCE*), associated with chromosome *r* once, with

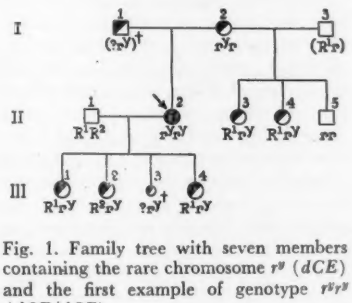

Fig. 1. Family tree with seven members containing the rare chromosome r^y (*dCE*) and the first example of genotype $r^y r^y$ (*dCE/dCE*).

Table 1. Summary of reactions with five antiserums. Siblings II-3, II-4, and II-5 were products of the second marriage. Their father was not available for testing.

Member	Anti- D	C	E	c	e	Genotype	
I-2 Mother	o	+	+	+	+	*dCE/dce*	$r^y r$
II-1 Husband of propositus	+	+	+	+	+	*DCe/DcE*	R^1R^2
II-2 Propositus	o	+	+	o	o	*dCE/dCE*	$r^y r^y$
III-1	+	+	+	o	+	*DCe/dCE*	$R^1 r^y$
III-2	+	+	+	+	o	*DcE/dCE*	$R^2 r^y$
III-4	+	+	+	o	+	*DCe/dCE*	$R^1 r^y$
II-3 Sibling	+	+	+	o	+	*DCe/dCE*	$R^1 r^y$
II-4 Sibling	+	+	+	o	+	*DCe/dCE*	$R^1 r^y$
II-5 Sibling	o	o	o	+	+	*dce/dce*	rr

R^1 four times, and once with R^2. In addition, r^y (*dCE*) must have been present in the blood of I-1, the deceased father of the propositus, and also in the fatally affected infant III-3.

This family tree, excluding the random I-3 and II-1 (whose genotype can be constructed) consists of 10 individuals, and among them there are 10 r^y (*dCE*) chromosomes, the absence in II-5 being neutralized by its presence in double dose in the propositus II-2. As could have been anticipated from the rarity of the chromosome involved, the parents of the propositus, I-1 and I-2, were consanguineous, each contributing one r^y (*dCE*) chromosome to the propositus.

This unique family provided an opportunity to study the suppression of D by its partner chromosome containing factor C, first described by Ceppellini, Dunn, and Turri (*2*). This suppression is exerted not only by chromosome r' (*dCe*) but also by chromosome r^y (*dCE*). A new variety of suppression of factor c in certain combinations was also observed (*3*).

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References and Notes

1. R. Race and R. Sanger [*Blood Groups in Man* (Thomas, Springfield, Ill., 1954)] estimate that chromosome r^y (*dCE*) should have a frequency of 1 in 48 million. Thus, one homozygote can be expected in testing about 400 million individuals in Western Europe. A. S. Wiener [*Am. J. Human Genet.* **1**, 127 (1949)] calculates that the homozygote has an incidence of 1 in 100 million.
2. R. Ceppellini, L. C. Dunn, M. Turri, *Proc. Natl. Acad. Sci. U.S.* **41**, 283 (1955).
3. A discussion of these findings is in preparation.

4 March 1957

Book Reviews

William Heytesbury. Medieval logic and the rise of mathematical physics. Curtis Wilson. University of Wisconsin Press, Madison, 1956. xii + 219 pp. $4.

Since the beginning of Pierre Duhem's work, in 1903, we have been aware that Galileo's mechanics was somewhat less miraculous than it had appeared to be, since 14th- and 15th-century logicians of the school of "Modern Logic" had deviated from Aristotelian physics in the same direction as that which the great Pisan was to explore so successfully. Deriving from William of Occam, these teachers, principally at the universities of Paris and Oxford, are gradually coming into clearer view through the exacting labor of the few scholars who possess the requisite training in mathematics, philosophy, and language. William Heytesbury, the subject of the present book, was described, as recently as 1955, in Gilson's *History of Christian Philosophy in the Middle Ages,* as being "little more than a name."

Whatever obscurity he may have fallen into, Heytesbury was once an influential teacher and writer and no slavish mouthpiece of the Aristotelian philosophy-cosmology which formed the intellectual environment of his time. The present study is concerned with the elucidation of a portion of one of Heytesbury's works —a portion in which he deals with physics and mathematics in a way that shows the same awareness of Aristotle's shortcomings as that which marked Galileo's thinking about two and a half centuries later. Two and a half centuries was a long time, even in the Middle Ages, and a perusal of Curtis Wilson's closely reasoned discussion at once illuminates the critical attitude of the 14th century toward traditional physics and the limitations of the academic environment, which precluded any leap at that time into "Galilean" physics. In Heytesbury's work, concludes Wilson, "mathematics is employed in the service of classification, *i.e.,* of the correction and elaboration of everyday speech." In this, Heytesbury differed from Aristotle, who, in his physics, showed no such awareness of any need for the correction of everyday speech, and from Galileo, to whom mathematics was the direct key to the world, without the intervention of everyday speech. Other aspects of Heytesbury's physics show affinities with the 19th-century discussions which led to the logical foundations of the calculus.

As in the case of a work of pure science, the popularity of this book is likely to be in inverse proportion to its originality. It is more likely to please the rare-book dealer of the next generation than the publisher of this generation. The University of Wisconsin Press is to be congratulated for considering the importance of the work ahead of the likelihood of its immediate popularity.

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Report of the Princeton Conference on the History of Philanthropy in the United States. Russell Sage Foundation, New York, 1956. 84 pp. $1.

American social philosophers have long agreed that wealth cannot expect public approval unless it contributes to the advancement of human welfare. "They should own who can administer, not they who hoard and conceal," wrote Ralph Waldo Emerson; "they whose work carves out the work for more, opens a path for all." More than any other people, Americans have turned their private fortunes to public account through philanthropy. They have relieved distress at home and abroad, have endowed schools and churches, have supported art galleries and museums, and have subsidized the quest for new social and scientific knowledge. Important as philanthropy has been in our national life, we know very little about it. Some of the great foundations now feel that they can profit by the discovery of new knowledge concerning the historical role of philanthropy in the United States.

At Princeton, on 3–4 Feb. 1956, a group of historians met with representatives of the Ford Foundation and the Russell Sage Foundation (sponsor of the conference) to discuss research possibilities in this field. *Report of the Princeton Conference on the History of Philanthropy in the United States* summarizes the results of that conference. Richard H. Shryock, of the Johns Hopkins University, and Henry Edward Guerlac, of Cornell University, who represented the history of medicine and the history of science, respectively, participated in the discussions. Their influence is revealed in the suggestions for further study of the role of philanthropy in the promotion of scientific research, in the creation of such agencies as the Smithsonian Institution and the Chicago Natural History Museum, and in the support of medical education, hospitals, and various public health programs. The conferees venture the opinion that the task of studying philanthropy in its scientific role belongs more properly to the historian of science than to the scientist, who may not be able to relate his specialty to broad historical movements and social goals.

The bulk of the report deals with the relation of philanthropy to government, law, the economy, the arts, education, religion, and other such matters. Interested parties will find a great variety of research topics suggested here, together with an extensive preliminary bibliography. Because of its comprehensiveness, the report is likely to fulfill the object of its sponsors by stimulating research in many different areas. Anyone who contemplates research in this field should also read the article on "The history of American philanthropy as a field of research" [*American Historical Review* (January 1957)] by Merle E. Curti, the distinguished historian who presided at the Princeton conference.

The Ford Foundation, which made an earlier grant for a study of English philanthropy, has recently awarded the University of Wisconsin $100,000 for American philanthropic studies. Curti, who will head the Wisconsin project, will undoubtedly welcome research suggestions from members of the scientific community.

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Introductory Psychosomatic Dentistry. John H. Manhold, Jr. Appleton-Century-Crofts, New York, 1956. 193 pp. Illus.

Introductory Psychosomatic Dentistry is a contribution to the expanding list of published materials that concern psychosomatic medicine and dentistry. The book introduces, at relatively great length, material on statistics and research methods for studying dental caries and for establishing a causal relationship to personality disorders. It is a moot question whether dental caries, because of the multiplicity of factors that participate in its causation, can be selected as the appropriate index for establishing a

causal relationship between personality disorders and dental disease. We should perhaps direct our investigation toward observing the musculoskeletal phenomena as exhibited in habit neurosis and other forms of occlusal trauma, such as bruxism, as well as peculiarities in general behavior.

Hypnosis is discussed early in the book in a section entitled "What is psychosomatics," where the emphasis is placed on what psychosomatics is *not*. The negative character of the discussion on hypnosis is neither warranted nor substantiated, and this section does not contribute to the main theme. The value of hypnosis is currently recognized by many experts as an aid in diagnosis of symptoms and disorders of psychogenic origin, such as conversion hysteria and other organ language disorders. The application of psychosomatics to dentistry is reserved for the final chapters and is presented without any attempt to relate sharply, for the dental practitioner, the body of information which is the substance of the book.

The book merits reading by interested persons because of the effort that is made to collate the material. It is to be hoped that it will stimulate more insight into psychosomatic investigation in dentistry.

More emphasis should have been placed on doctor-patient rapport and on the elusive problems in dentistry that, in many instances, *are* elusive because they have become entangled with emotional disorders of various types. All in all, the book is well written, makes for good reading, and contains many instructive pages for dentists who are interested in psychosomatic dentistry.

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Annual Review of Nuclear Science. vol. 6. James G. Beckerley, Martin D. Kamen, and Leonard I. Schiff. Annual Reviews, Palo Alto, Calif., 1956. 741 pp. Illus. $7.

As the journals that publish detailed accounts of individual experiments become thicker and proliferate in number, the importance of the review article steadily rises. Only the unusual researcher has time to read the original papers, as they appear, in other than the minute area of science in which he is at the moment working. For collateral information, he is dependent on reviews, and, as such, the articles in volume 6 of the *Annual Reviews of Nuclear Science* are very valuable.

The first article, by V. Sarabhai and N. W. Nerurkar, summarizes advances that have been made in the study and interpretation of the time variations in cosmic-ray intensity. Before multi-Bev particle accelerators became available, problems concerning the origin of cosmic rays and their variations were subordinated to the use of the rays as projectiles with which to initiate ultrahigh energy events. These neglected problems are now in the focus of scientific interest, and the article discusses such matters as the evidence for solar generation of part of the radiation and for the existence and location of interplanetary magnetic fields.

An article by L. Wolfenstein reviews material concerning the polarization of nucleon beams. The rather sophisticated formalism used in the mathematical description of polarized particle beams is presented, and the interpretation of recent data in the 100- to 400-Mev region of kinetic energy is discussed.

N. P. Heydenberg and G. M. Temmer, who have themselves contributed greatly to the field of the Coulomb excitation of nuclei, summarize the status of such investigations in a very valuable review. J. E. Mack and H. Arroe, two able spectroscopists, review recent work on the isotope shift in atomic spectra in a highly condensed article which, nevertheless, lists 158 original papers.

The Nuclear Data Group at the National Bureau of Standards, headed by K. Way, present an exhaustive summary of recent material on the ground-state spins, magnetic moments, quadrupole moments, energy levels, and gamma-ray lifetimes of "medium weight nuclei," assigning nuclei with $22 < N < 90$ and $114 \leq N \leq 134$ to this category. A discussion of the bearing of these data on various current nuclear models is included.

An article by R. A. Horne, C. D. Coryell, and L. S. Goldring discusses the role of acidity in certain types of radiochemical separations, notably those involving the hydrolysis of metals and the precipitation of their hydroxides or sulfides. A generalized concept of acidity is used in extending the review to nonaqueous solutions and liquid salts.

An extensive review of the masses of light nuclides by a group at the Max Planck Institute for Chemistry at Mainz, Germany, headed by J. Mattauch, attempts to derive the most probable masses from mass spectroscopic and nuclear data and discusses their differences. The tables in this article have been so drastically reduced in the reproduction process that they cry for the use of a magnifying glass, at least, so I thought.

Nuclear radiation effects in solids is the subject of an article by H. Brooks. Since 1942, when E. P. Wigner first anticipated that the graphite used in the Hanford piles might deform under the intense fast neutron bombardment, the field has grown tremendously, owing to its vital importance in reactor design and its interest to solid-state physicists.

Applications of oxygen isotopes in chemical studies are discussed by H. Taube. The article stresses the applications to chemical phenomena in homogeneous solution.

E. C. Anderson and F. N. Hayes discuss recent advances in low-level counting techniques. Brilliant success in radiocarbon dating was achieved by means of these techniques, and they are now being applied to the fundamental problems of the detection of the neutrino and of double beta decay.

"Nuclear reactors for electric power generation" is the subject of a review by L. Davidson, W. A. Loeb, and G. Young. After discussing various types, here and abroad, they attempt to answer the vexing question of the cost per kilowatt hour of electricity that must be anticipated.

The volume closes with two review articles on radiobiology. The first, on cellular radiobiology, by L. H. Gray, has two subheads, "Radiobiology of the cell" and "Radiobiology of cells and tissues," with an imposing list of 380 original papers. The second radiobiological article, by J. P. O'Brien, is titled "Vertebrate radiobiology: embryology" and discusses the development of vertebrate embryos after high-energy irradiation in the fetal state. It contains a brief statement concerning human infant development as observed in post-World War II Hiroshima and Nagasaki.

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Fusion Methods in Chemical Microscopy. Walter C. McCrone, Jr., Interscience, New York, 1957. 307 pp. Illus. $6.75.

Fusion Methods in Chemical Microscopy is a useful handbook of techniques for methods of microanalysis that depend on the combination of microscope and temperature control. The methods generally involve melting and are referred to collectively as "fusion methods." Temperatures generally employed are in the range $-100°$ to $+350°C$, but with special apparatus the range can be greatly extended. The techniques are usable for any substances that can be heated on a microscope stage, but emphasis in this book is on applications to organic compounds.

The microscope has long been used to some extent in inorganic analysis for identifying precipitates, and it is of course the principal tool for mineralogic analysis of rocks. In organic chemistry, neither the simple recognition of pre-

cipitates nor the accurate measurement of crystallographic properties has proved widely useful, but the fusion methods described in this book show much promise. Advantages claimed for these methods are the simplicity of the apparatus, the speed with which tests can be carried out, and the adaptability of the methods for use by operators with limited training.

The book has a brief chapter on apparatus, with abundant references to original literature. The longest section of the text is devoted to detailed description of techniques, including identification of compounds, analysis of mixtures, and determination of temperature-composition diagrams. Particularly interesting are the ingenious methods for purifying minute amounts of compounds and for rapidly measuring such properties as refractive index, birefringence, and dispersion. One of the special accomplishments of the fusion technique is the working out, quickly and easily, of temperature-composition diagrams. Several research applications of the method are discussed briefly. The book concludes with identification tables for 1200 organic compounds, arranged according to melting points, then according to eutectic melting points with ten standard compounds, and finally according to refractive indices at various temperatures.

The book has little theoretical material and makes few demands on the reader beyond an elementary knowledge of organic chemistry, crystallography, and microscope techniques. It is abundantly and beautifully illustrated, both with black-and-white photographs and with several color plates showing interference colors.

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Physiologie de l'Insecte. Les grandes fonctions, le comportement, écophysiologie. Rémy Chauvin. Institut National de la Recherche Agronomique, Paris, ed. 2, 1956. 917 pp. Illus. $9.50.

This is the second edition, extensively revised, of a book that was first published in 1949. It reflects, in its encyclopedic bulk, the rapid development of insect physiology in the last 8 years. It now has the fleeting advantage of being the most up-to-date exposition of insect physiology, since V. B. Wigglesworth's *Principles of Insect Physiology*, second edition, is 6 years old.

Despite its youth, this book is inferior in many of those elements that are essential to a critical review: carelessness is symptomatized by frequent bibliographic errors, some of which have been carried over from the first edition, and suppression of the critical faculty, perhaps from a desire to achieve impartiality, has caused juxtaposition of data of widely varying credibility.

Although these shortcomings make this a dangerous book for the beginner, its comprehensiveness makes it useful as a guide to the literature. In terms of emphasis it differs from Wigglesworth's *Principles of Insect Physiology* mainly in its more extensive consideration of insect biochemistry.

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Scientific Research in British Universities, 1955–56. H. M. Stationery Office, London, 1956 (order from British Information Services, 45 Rockefeller Plaza, New York 20, N.Y.). 372 pp. $3.78.

Scientific Research in British Universities, 1955–56, which is published annually by the Department of Scientific and Industrial Research, is commended to American scientists who may be interested in visiting or exchanging information with workers in British universities and university colleges. Current research projects in each university department are listed, together with the names of the research workers. Name and subject indexes make the book easy to use.

New Books

L'Evolution de la Lithosphère: Orogénèse. vol. III (pts. 1 and 2) of *Traité de Géologie.* Henri Termier and Genevieve Termier. Masson, Paris, 1956; 1957. 498 pp.; 437 pp. F. 9800 per volume.

Electricity and Magnetism. J. Newton. Philosophical Library, New York, 1956. 622 pp. $10.

The History of Mathematics. Joseph Ehrenfried Hofmann. Translated from the German by Frank Gaynor and Henrietta O. Midonick. Philosophical Library, New York, 1957. 143 pp. $4.75.

Canadian Cancer Conference. vol. 2. Proceedings of the second Canadian Cancer Research Conference, Honey Harbour, Ont., 17–21 June 1956. R. W. Begg, Ed. Academic Press, New York, 1957. 410 pp. $8.50.

Archaeology in the U.S.S.R. Mikhail Miller. No. 3 of *Research Monographs* of the Research Program on the U.S.S.R. Praeger, New York, 1956. 232 pp. $5.

The Next 50 Billion Years. An astronomer's glimpse into the future. Kenneth Heuer. Viking, New York, ed. 2, 1957. 144 pp. $3.

1001 Questions Answered about the Seashore. N J. Berrill and Jacquelyn Berrill. Dodd, Mead, New York, 1957. 317 pp. $5.

An Introduction to Semiconductors. W. Crawford Dunlap, Jr. Wiley, New York; Chapman and Hall, London, 1957. 438 pp. $11.75.

Introduction to Organic Chemistry. Louis F. Fieser and Mary Fieser. Heath, Boston, 1957. 616 pp. $7.

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Meetings and Societies

Preliminary Announcement of Indianapolis Meeting and Call for Papers by AAAS Sections

The annual meeting of the American Association for the Advancement of Science for the year 1957, 26–31 Dec., will be the 124th national meeting. It will be the association's first meeting in the Midwest in 5 years and a return to Indianapolis, for the fourth time, after an interval of 20 years. Among those present will be a sizable number who can recall the successful AAAS meeting of 1937 and a whole generation of younger research scientists, teachers, and other science-minded professional men and women.

The fundamental, original purpose of the association when it was founded in September 1848, was ". . . by periodical and migratory meetings to promote [exchange of ideas among] those who are cultivating science." The annual meeting is still a major activity of the AAAS. With some 53,000 members and 271 affiliated scientific organizations, the association more than ever is prepared to consider matters of concern to all scientists and to society. The sessions of the 18 sections, which embrace all principal fields of science, and of the participating societies both meet the interests of specialists and provide unique opportunities for interdisciplinary programs. In recent years the association has also increasingly recognized its responsibility to inform the general public on developments in science and its obligation to assist in the encouragement of qualified young people to prepare for and enter careers in science, engineering, and education. The programs this year will reflect these objectives.

Center of the meeting will be the attractive and well-equipped Murat Temple which, with its capacious theater and three levels, will accommodate the larger sessions, the Annual Exposition of Science and Industry, the AAAS Main Registration-Information Center, AAAS Office, and the AAAS Science Theatre. The Temple will be the site of the AAAS Smoker for all registrants on the evening of 29 Dec. The Turners Athenaeum, immediately across the street, will provide additional session rooms. Although the Murat Temple and the Athenaeum are within walking distance of all downtown hotels, there will also be special AAAS buses which will operate at frequent intervals between the Temple and the hotels. These will make it possible for everyone to visit the large-scale exhibits of the latest in the tools and materials scientists use and many of the technical accomplishments of large industries.

Among the downtown hotels, which have guaranteed a minimum of 2500 rooms for the AAAS, the remodeled Claypool will serve as AAAS headquarters. The Antlers has been assigned to the four science teaching societies, and the Marott to the American Astronomical Society. Other hotel headquarters assignments in the Sheraton-Lincoln, Continental, Severin, Warren, and Washington will be announced in July, at which time the advertising pages of this journal will begin to carry housing reservation and advance registration coupons. As usual, advance registrants will receive the book-size General Program-Directory early in December by first-class mail.

Local committees. No AAAS meeting could succeed without the interest and substantial assistance of local members and friends of the association. General chairman of the fourth Indianapolis Meeting is Adam H. Fiske, vice president, Eli Lilly and Company, and he has appointed the following as chairmen of their respective committees: Advisory, H. T. Pritchard, president, Indianapolis Power and Light Company; Exhibits, Edward B. Newill, president, Allison Division, General Motors Corporation; Finance, Joseph E. Cain, president, P. R. Mallory Company; Housing, William A. Atkins, president, Severin Hotel Company; Physical Arrangements, Newton G. Sprague, science and mathematics consultant, Indianapolis Public Schools; Public Relations, James W. Carr, Sr., executive secretary, Riley Memorial Association. An Honorary Reception Committee will also be formed.

Programs. Among the evening events will be the AAAS Presidential Address and Reception, 28 Dec. President Laurence H. Snyder will preside and Paul B. Sears will give his address as retiring president. The combined Sigma Xi-RESA address and the annual address of the United Chapters of Phi Beta Kappa are planned for 27 Dec., and the annual lecture and film of the National Geographic Society is scheduled for 29 Dec., preceding the AAAS Smoker.

The evening of 26 Dec. and the afternoon of 27 Dec. have been reserved for the two sessions of the AAAS General Symposium, "Moving frontiers of science II: Concepts that mold our lives," organized by the Committee on AAAS Meetings. Three eminent speakers, three panelists, a moderator, and a summarizer, all of whom will have met together well in advance, will discuss relativity, organic evolution, and the individuality of man. Because of the general interest of this program, all AAAS sections and most of the participating societies have scheduled no sessions concurrent with it.

The 11th annual Junior Scientists Assembly, sponsored by the association's Academy Conference and cosponsored by the AAAS as a whole—a full afternoon program for high-school students interested in careers in science—will be arranged by a committee, of which Richard Armacost, department of biology, Purdue University, is chairman. The Academy Conference, composed of representatives of the 41 academies of science affiliated with the AAAS, this year will be concerned in large part with ways and means to assist the junior academies.

The sixth Conference on Scientific Editorial Problems will consider various aspects of communications and technical writing and editing. This year's program committee is headed by George L. Seielstad, Applied Physics Laboratory, Johns Hopkins, Silver Spring, Md. The recurrent Conference on Scientific Manpower, this year with two sessions described later, again will be arranged by a committee with Thomas J. Mills, National Science Foundation, as chairman. As the following synopsis of programs indicates, there will be interesting and important programs in all principal fields of science. The names given within parentheses are section officers or program chairmen.

Mathematics (A)

Section A (C. C. MacDuffee, University of Wisconsin) will sponsor an important symposium on the teaching of mathematics, to be arranged by John R. Mayor, director, AAAS Science Teaching Improvement Program. It will be cosponsored by the association as a whole and by the AAAS Cooperative Committee on the Teaching of Science and

Mathematics. A session for invited and contributed papers on the mathematics of guided missiles is scheduled for 28 Dec. and the vice-presidential address will be given by Mina Rees, Hunter College.

The recently affiliated *Association for Computing Machinery* (James E. Robertson, Digital Computer Laboratory, University of Illinois), will hold one of its two annual national meetings with the AAAS in Indianapolis.

Physics (B)

Section B (J. Howard McMillen, National Science Foundation) has scheduled a three-session symposium, "Spectroscopy," of 13 papers, arranged by K. W. Meissner, Purdue University, covering experimental, theoretical, and applied aspects of the subject. Part I, Friday morning, 27 Dec., will be devoted to wavelength standards, vacuum ultraviolet spectroscopy, and isotope shift. The second session on Saturday morning will deal with the spectra of lanthanides and actinides and with Lamb shift. Two papers to be given in the afternoon session of Saturday concern the theory of atomic spectra and the theory of spectra of diatomic molecules. Two other papers will be devoted to applications of spectroscopy. The speakers will be: V. A. Fassel and W. A. Gordon, Iowa State College; Mark Fred, Argonne National Laboratory; Gerhard Herzberg, National Research Council of Canada, Ottawa; Julian E. Mack, University of Wisconsin; J. Rand McNally, Jr., Oak Ridge National Laboratory; William F. Meggers, National Bureau of Standards; K. W. Meissner, Purdue University; R. S. Mulliken, University of Chicago; F. Rohrlich, State University of Iowa; Charlotte M. Sitterly, National Bureau of Standards; Frank S. Tomkins, Argonne National Laboratory; R. Tousey, U.S. Naval Research Laboratory; and P. G. Wilkinson, University of Chicago.

Special talks on neutrino physics, solid-state physics, and high-temperature plasma will also be given.

The physicists' dinner, 27 Dec., will be joint with *Sigma Pi Sigma* (James M. Kortwright, Purdue University) and will be followed by the vice-presidential address of Section B given by William F. Meggers, with Raymond T. Birge, University of California, presiding.

The *American Meteorological Society* (Kenneth Spengler, AMS, Boston) will cosponsor appropriate sessions.

Chemistry (C)

The program of *Section C* (F. E. Cislak, Reilly Tar & Chemical Corporation, Indianapolis) will consist of a two-session symposium on acetylene chemistry, another two-session symposium on pyridine chemistry, a series of sessions for contributed papers, and a vice-presidential address by Cislak.

Alpha Chi Sigma (R. L. Hicks, Broad Ripple High School, Indianapolis) will have a dinner meeting and address for all chemists.

Astronomy (D)

The *American Astronomical Society* (J. Allen Hynek, Smithsonian Astrophysical Observatory, Cambridge, Mass.) has scheduled its 99th national meeting with the AAAS, 27–30 Dec. The J. I. Holcomb Observatory and Planetarium of Butler University (Harry E. Crull, director) is cooperating. Features of the program will be the Helen Warner prize lecture, a symposium, "Distribution and evolution of intrinsically variable stars," and the annual dinner at which the vice-presidential address of *Section D* will be given by Peter van de Kamp, Swarthmore College, with Chester B. Watts, U.S. Naval Observatory, presiding. With the AAS providing a full program of sessions for contributed papers and other events, Section D's program will be restricted to cosponsorship of the AAS program and the retiring vice-presidential address.

The *Astronomical League* (Grace C. Scholz, Mason Hall Apartments, Alexandria, Va.) will have a half-day session.

Geology and Geography (E)

The program of *Section E* (Frank C. Whitmore, Jr., and Louis L. Ray, U.S. Geological Survey, Washington, D.C.) includes a symposium on the history of geology cosponsored by Section L; a symposium on karst phenomena, arranged by William E. Davies, U.S. Geological Survey, Washington, D.C., jointly with the National Speleological Society; a two-session symposium on the stratigraphy and structural geology of the Michigan and Illinois basins area; a four-session symposium, "Continental glaciation and its geographic importance as an environmental factor" with special emphasis on the midwestern states; and sessions for contributed papers in both geology and geography, these last jointly with the *Association of American Geographers* (Louis L. Ray, U.S. Geological Survey, Washington, D.C.), which will also cosponsor the glaciation symposium. As usual, the *Geological Society of America* will cosponsor all geologic sessions including the Section E Smoker at which the retiring vice-presidential address of Paul F. Kerr, Columbia University, will be given, with Robert R. Shrock, MIT, presiding.

The *National Speleological Society* (Thomas C. Barr, Jr., 1100 Clifton Lane, Nashville, Tenn.), in addition to cosponsoring Section E's karst symposium, will have a session for papers and a symposium, "Caves and cave fauna of the Ohio River valley" on 28 Dec. The *National Geographic Society* will have its customary outstanding lecture and accompanying film on the evening of 29 Dec.

Zoological Sciences (F)

Section F (Harold H. Plough, Amherst College) will have sessions for contributed papers and demonstrations in several fields of zoology, cosponsored, it is anticipated, by appropriate societies; a symposium, "Recent advances in the understanding of pituitary function," arranged by W. R. Breneman, Indiana University; a two-session symposium, "Some unsolved problems in biology II," jointly with Section G; another symposium, "The geographic distribution of contemporary organisms"; a business meeting; and a dinner for all zoologists, jointly with the Society of Systematic Zoology, at which E. Raymond Hall, University of Kansas, will give the vice-presidential address of Section F. A symposium on radiation biology, sponsored by the Argonne National Laboratory (Austin M. Brues), is planned.

The national meeting of the *Society of Systematic Zoology* (R. E. Blackwelder, St. John Fisher College, Rochester, N. Y.) will follow the pattern of former meetings, with sessions for contributed papers and demonstrations, one or more panels or symposia, evening lectures, a tea, and a business meeting. A feature will be the annual SSZ Library and Lounge for all zoologists.

Biological Sciences (FG)

Beta Beta Beta Honorary Biological Society (Mrs. Frank G. Brooks, Box 336, Madison Square Station, New York 10, N.Y.) will hold its regular biennial meeting with the AAAS. The program—a business meeting, luncheon, and address—will be on 27 Dec. The *Ecological Society of America* (Stanley A. Cain, University of Michigan) will have its usual regional meeting with the association and plans three or more sessions for contributed papers and cosponsorship of appropriate symposia.

The annual national meeting of the *National Association of Biology Teachers* (Irene Hollenbeck, Southern Oregon College of Education) will begin with business meetings 26 Dec. It will include a separate session on "Outdoor biology" and a luncheon on 27 Dec., a joint meeting with the ANSS, NARST, and NSTA, and a session on "Methods and techniques: problem-solving in biology" on 28 Dec., with J. Darrell Barnard, New York University, the keynote speaker. A field trip with the American Nature Study Society, 29 Dec., will conclude

their meeting. It is expected that the *American Society of Naturalists* (Bruce Wallace, Cold Spring Harbor, N.Y.) will either arrange a symposium or cosponsor one in the F, FG, or G series.

Botanical Sciences (G)

In addition to "Some unsolved problems in biology II," jointly with Section F, *Section G* (Barry Commoner, Washington University) will have sessions for contributed papers in the principal fields of botany, cosponsored probably by the *American Society of Plant Physiologists,* the Ecological Society of America, and others. Other symposia are planned, and, following the annual botanists' dinner, the vice-presidential address of Section G will be given by Harry J. Fuller, University of Illinois.

Anthropology (H)

The plans of *Section H* (Gabriel W. Lasker, School of Medicine, Wayne State University) are yet to be announced but probably will include one or more symposia and the vice-presidential address of William L. Straus, Jr., of Johns Hopkins University.

Psychology (I)

Section I (Clifford T. Morgan, Town Point, Cambridge, Md.) will have six sessions of invited papers covering the principal areas of research activity in psychology. The vice-presidential address will be given by Neal Miller of Yale University.

The Society for Research in Child Development (Dale B. Harris, Institute of Child Welfare, University of Minnesota) is planning a regional meeting.

Social and Economic Sciences (K)

Section K and the *National Academy of Economics and Political Science* (Donald P. Ray, George Washington University) will jointly sponsor a symposium of general interest, "The social aspects of urban agglomeration." The three papers of this session, cosponsored by the *American Economic Association,* will deal with metropolitan expansion and public administration, the economic implications of urban growth, and statistical programming for problems of urban agglomeration—this last the vice-presidential address of Stuart A. Rice. *Pi Gamma Mu,* the national honorary society in the social sciences, it is anticipated, will have a dinner for the speakers. In addition, for the first time in many years, Section K will open sessions for contributed papers in the social and economic sciences.

The *American Sociological Society* (Raymond V. Bowers, Air Research and Development Command, and Conrad Taeuber, Bureau of the Census) plans a special meeting with the AAAS, and the *American Political Science Association* (Evron M. Kirkpatrick, APSA, Washington, D.C.) is considering a special program jointly with Section K.

The *Society for the Advancement of Criminology* (Donal E. J. MacNamara, New York Institute of Criminology) will have a four-session symposium, "Advances in scientific criminology," two luncheons with speakers, and an evening seminar on crime and police problems.

The *American Statistical Association* (Virgil L. Anderson, Statistical Laboratory, Purdue University) is planning a regional meeting, and the *Metric Association* (J. T. Johnson, Claremont, Calif.) may have a joint program with Section C or Np.

History and Philosophy of Science (L)

The program of *Section L* (C. Doris Hellman, c/o Pepper, 1065 Lexington Ave., New York 21, N.Y.) will include a symposium, "Man's changing view of his place in nature," a session for contributed papers, and a business meeting, all on 29 Dec. The *Philosophy of Science Association* (C. West Churchman, Case Institute of Technology) is planning several sessions, and the *Society for General Systems Research* (Richard L. Meier, 1137 E. Ann St., Ann Arbor, Mich.) will hold its annual meeting with the AAAS. One session will be "Organization—for humans, cells, and artifacts."

Engineering (M)

Section M will have a symposium of several sessions (Irving P. Orens, Newark College of Engineering) on "Measuring man's environment: the physical effects on man of light, temperature, sound, and air," cosponsored by the *American Industrial Hygiene Association* and others. The Engineering Manpower Commission will cosponsor the sessions of the Conference on Scientific Manpower.

Medical Sciences (N)

As in previous years, *Section N* will have a four-session symposium, the participants of which come from all parts of the continent. This symposium, cosponsored by the *Society for Investigative Dermatology* and the *American Medical Association Committee on Cosmetics,* is scheduled for 28 and 29 Dec. This year's subject, "The human integument: normal and abnormal" (Veronica L. Conley, AMA, Chicago) will include papers on the biochemistry and physiology of the normal skin, pathological conditions such as melanosis, and the therapeutic principles involved in correcting abnormalities; included will be the vice-presidential address of William B. Bean, and the announcements of the 13th Theobald Smith award, given by Eli Lilly and Company, the third AAAS–Anne Frankel Rosenthal Memorial Award in Cancer Research, and the second AAAS–Ida B. Gould Memorial Award for Research on Cardiovascular Problems. Section N will cosponsor a variety of appropriate programs.

Alpha Epsilon Delta (Maurice L. Moore, national secretary) will have its customary morning session—this year on the coordination and integration of undergraduate and professional education in the health sciences—the annual luncheon with a speaker of prominence, and a tour of the facilities of the Indiana University Medical Center.

The *American Psychiatric Association* (Milton Greenblatt, Massachusetts Mental Health Center, Boston) will have a multisession symposium on the social aspects of tranquilizing drugs. Details of the special programs of the *American Association of Hospital Consultants* (Jacque B. Norman, Greenville, S.C.) and the *American Physiological Society* (Fred A. Hitchcock, Ohio State University) are not yet available.

Dentistry (Nd)

The two-day program of *Section Nd* (Maynard K. Hine and Joseph C. Muhler, School of Dentistry, Indiana University, Indianapolis), 27 and 28 Dec., will be centered at the Indiana University Medical Center. A three-session symposium, "The pharmacology and toxicology of fluorine," will deal with the effects of fluoride on the body excluding dental caries, with particular reference to cardiovascular diseases, kidney diseases, mortality and morbidity rates, effect on enzymes, effects of fluoride retention within the body, and a comparison between fluorides provided from natural and artificial sources. One or more sessions for contributed papers on fluoride will probably be opened, and group luncheons are planned. The entire program of the section will be cosponsored by the *American College of Dentists,* the *American Dental Association,* and the *International Association for Dental Research, North American Division.*

Pharmacy (Np)

The four-day program of *Section Np* (John E. Christian, School of Pharmacy, Purdue University) begins 27 Dec. with a morning session for contributed papers and continues with symposia, "The latest developments in the tranquilizer field—pharmacological, chemical, and clinical" and "Recent trends in new medication." Other sessions, for contributed papers, will include those of the *American Society of Hospital Pharmacists* (George E. Archambault, Pharmacy

Branch, USPHS, Washington, D.C., in collaboration with Joseph Oddis, American Hospital Association, Chicago). There will be a pharmacists' dinner, a vice-presidential address by Robert C. Anderson, Eli Lilly and Company, and a social hour, 28 Dec. After the session for contributed papers on 30 Dec., a half-day tour of the Eli Lilly laboratories is planned. Section Np's entire program will be cosponsored by the *American Association of Colleges of Pharmacy,* the *American College of Apothecaries,* the *American Pharmaceutical Association, Scientific Section,* and the American Society of Hospital Pharmacists.

Agriculture (O)

Section O (L. P. Reitz, Plant Industry Station, Beltsville, Md.) will have a four-session symposium on the biological and chemical control of plant and animal pests, 28–29 Dec., followed by two or more sessions for volunteer papers restricted to the same subject.

Industrial Science (P)

Section P (Frank C. Croxton, Battelle Memorial Institute) will have its second Industrial Citation Dinner on 26 Dec., a symposium of interest to leaders in industry the morning of 27 Dec., followed by a luncheon at which the retiring vice-presidential address of Monroe E. Spaght, Shell Oil Company, New York, will be given.

Education (Q)

The program of *Section Q* (Herbert A. Smith, University of Kansas) includes two sessions joint with the *International Council for Exceptional Children,* 26 Dec.; two sessions joint with the *American Educational Research Association,* 30 Dec.; four sessions for contributed papers, 28–30 Dec.; a business meeting, 29 Dec., with the vice-presidential address of Arthur E. Traxler, Educational Records Bureau, New York, preceding it. The *AAAS Cooperative Committee on the Teaching of Science and Mathematics* (Bernard B. Watson, 2806 Blaine Drive, Chevy Chase, Md.) will cosponsor Section A's symposium on the teaching of mathematics.

The four science teaching societies meeting with the AAAS (coordinator, Paul Klinge, Thomas Carr Howe High School, Indianapolis) will have a joint mixer the evening of 27 Dec. The joint session the morning of 28 Dec. will complement the preceding AAAS General Symposium, "Concepts that mold our lives." The speakers and panel members will cover relativity, organic evolution, and the individuality of man with special reference to the implications for teachers and those whom they teach.

The separate portions of the program of the regional meeting of the *National Science Teachers Association* (Richard W. Schulz, Emmerich Manual Training High School, Indianapolis, and Robert H. Carleton, NSTA, Washington, D.C.) consists of a meeting of the executive committee, a session and industrial field trips on 27 Dec., and three other sessions on 28 and 29 Dec. The *National Association for Research in Science Teaching* (George G. Mallinson, Western Michigan University) will have a two-session symposium, "Recent research in science education," on 27 Dec.

Science in General (X)

The annual *Academy Conference* (Father P. H. Yancey, Spring Hill College, Mobile, Ala.), composed of delegates and other members of the 41 academies affiliated with the association, will hold a day of sessions, 28 Dec., concluding with the annual dinner and presidential address by Mrs. B. G. Heatwole, Staunton, Va. Of particular concern this year will be a consideration of the proposals of the conference on junior academies held in Chicago, 15–16 Feb. The Academy Conference will sponsor the 11th annual Junior Scientists Assembly (Richard R. Armacost, Purdue University) the afternoon of 28 Dec.

The *American Geophysical Union* (Edward M. Brooks, Saint Louis University) is planning a regional meeting and will cosponsor appropriate programs.

The program of the annual national meeting of the *American Nature Study Society* (Richard L. Weaver, University of Michigan) begins with a board meeting 26 Dec. and includes, besides joint sessions with the science teaching societies, general sessions the morning of 27 Dec. and afternoon of 28 Dec. The annual dinner is 28 Dec., the annual showing of kodachromes, the evening of 29 Dec., following the joint field trip with the National Association of Biology Teachers.

The *Association of Technical Writers and Editors* (Richard Frehsee, International Business Machines Corporation, Endicott, N.Y.) may have sessions of its own in addition to participating in the program of the *Conference on Scientific Editorial Problems* mentioned earlier.

The recurrent *Conference on Scientific Manpower* (Thomas J. Mills, National Science Foundation) is planning two sessions of invited papers on "The status of scientists in a changing economy" and "Current scientific manpower developments at home and abroad," 30 Dec. As in previous years, this program will be cosponsored by the *Engineering Manpower Commission,* the *Scientific Manpower Commission,* the *National Academy of Sciences–National Research Council,* and the *National Science Foundation.*

The *National Foundation for Junior Museums* (John Ripley Forbes, NFJM, New York) is planning one or more sessions on the work of the foundation.

The national meeting of *Sigma Delta Epsilon,* graduate women's science fraternity (Mrs. Helen Bolton Parker, Malvern, Pa.) begins with a business meeting on 26 Dec. and includes the annual dinner and grand chapter meeting on 27 Dec., and a luncheon for all women in science on 28 Dec. A headquarters room will be maintained throughout the meeting period.

The annual joint address of the *Society of the Sigma Xi* (Thomas T. Holme, Yale University) and the *Scientific Research Society of America* (Donald B. Prentice, Yale University) and award of the William Procter prize is scheduled for the evening of 27 Dec., following the 58th annual convention of Sigma Xi, the annual convention of RESA, and their joint luncheon on that day.

The 18th annual lecture of the *United Chapters of Phi Beta Kappa* (Carl Billman, Phi Beta Kappa, Washington, D.C.) is scheduled for the evening of 27 Dec.

Call for Papers by AAAS Sections

Eleven sections of the association will arrange sessions for contributed papers at the Indianapolis meeting. In three instances, as will be noted, Sections A, Nd, and O, the papers to be considered are restricted to the subjects stated. The secretaries or program chairmen to whom titles and abstracts should be sent, *not later than 30 Sept. 1957,* follow:

A–Mathematics. Mathematics of guided missiles. Dr. C. C. MacDuffee, Department of Mathematics, University of Wisconsin, Madison, Wis.

C–Chemistry. Dr. F. E. Cislak, Reilly Tar & Chemical Corp., 11 S. Meridian St., Indianapolis 4, Ind.

E–Geology and Geography. Geology: Dr. Frank C. Whitmore, Jr., U.S. Geological Survey, Washington 25, D.C. Geography: Dr. Louis L. Ray, U.S. Geological Survey, Washington 25, D.C.

F–Zoological Sciences. Dr. H. H. Plough, Biology Department, Amherst College, Amherst, Mass.

G–Botanical Sciences. Dr. Barry Commoner, Henry Shaw School of Botany, Washington University, St. Louis 5, Mo.

K–Social and Economic Sciences. Dr. Donald P. Ray, Hall of Government, George Washington University, Washington 6, D.C.

L–History and Philosophy of Science. Dr. C. Doris Hellman, c/o Mrs. Morton Pepper, 1065 Lexington Ave., New York 21, N.Y.

ND–DENTISTRY. Fluoride. Dr. Maynard K. Hine, School of Dentistry, Indiana University, 1121 W. Michigan St., Indianapolis 2, Ind.

NP–PHARMACY. Dr. John E. Christian, School of Pharmacy, Purdue University, Lafayette, Ind.

O–AGRICULTURE. Biological and chemical control of plant and animal pests. Dr. Louis P. Reitz, Cereal Crops Section, Agricultural Research Service, USDA, Plant Industry Station, Beltsville, Md.

Q–EDUCATION. Dr. Herbert A. Smith, 205 Bailey, School of Education, University of Kansas, Lawrence, Kan.

Although the deadline is 30 Sept., most sections, and subsequently the AAAS office, would be glad to receive titles in advance of this date.

RAYMOND L. TAYLOR
Associate Administrative Secretary

International Conference on Peaceful Uses of Atomic Energy

The seven-member Advisory Committee on the Peaceful Uses of Atomic Energy, which convened on 6 May under the chairmanship of the Secretary-General of the United Nations, finished its session on 8 May. The principal task of the committee at this session was to advise the Secretary-General upon the date, place, organization and program of the second International Scientific Conference on the Peaceful Uses of Atomic Energy.

It has been decided that the second conference will be held in Geneva, 1–13 Sept. 1958. In reaching this conclusion, consideration was given to invitations for the conference which had been received on behalf of the cities of Chicago and Amsterdam, as well as an invitation from the Swiss Federal Council on behalf of Geneva.

The committee has formulated a topical agenda of wide scope for the 1958 conference and has also decided that the procedure for its organization will be similar to that of the 1955 conference. Any exhibitions under the aegis of the 1958 conference should be provided by participating governments only. They should be devoted to the scientific subjects dealt with at the conference. The matter will be considered further at a later meeting of the committee.

Religion and Science

The 1957 Conference on Religion in the Age of Science is scheduled for the week of 27 July–3 Aug. on Star Island, Isles of Shoals, off Portsmouth, N.H. At this fourth annual gathering of scholars and professional people in both science and religion to reformulate statements about questions of primary human concern in the light of science, the main theme is to be the problem of knowing. How have men, or animals for that matter, come to know what is right for them to do in order to have life and abundant life? How have cultural traditions on morals and religion evolved? How may the scientific approach to truth or reality participate in the revelation of the truth about man's ultimate concerns?

Persons of any religious or irreligious background are welcome to the conference, which is limited to 200. Scholarships for the week's expenses at the island are available to younger theologians, clergymen, and scientists. For a folder and further information, write to the registrar, Mrs. Rosalind Holt, Box 156, Pennington, N.J. The general character of the previous conferences can be reviewed by consulting *Science* **124**, 690 (12 Oct. 1956).

Vienna Bioclimatology Meeting

The National Science Foundation will award grants to defray partial travel expenses for a limited number of American scientists participating in the first scientific congress of the International Society of Bioclimatology and Biometeorology, which will meet in Vienna, Austria, 23–27 Sept. Application blanks may be obtained from the National Science Foundation, Washington 25, D.C. Completed forms must be submitted by *15 June*.

Society Elections

■ American Association of Pathologists and Bacteriologists: pres., Sidney Farber, Boston, Mass.; v. pres., Alan R. Moritz, Cleveland, Ohio; sec., Russell L. Holman, New Orleans, La.; treas., Brig. Gen. Elbert DeCoursey, San Antonio, Tex.

■ American Association of Anatomists: pres., Barry J. Anson; pres.-elect, Davenport Hooker; pres.-emeritus, E. A. Boyden; 1st v. pres., William W. Greulich; 2nd v. pres., O. V. Batson; sec.-treas., Louis B. Flexner.

■ South Carolina Academy of Science: pres., H. W. Davis, University of South Carolina; pres.-elect, G. B. Wolcott; v. pres., H. W. Freeman; sec.-treas., Margaret Hess, Winthrop College. Representative to the AAAS Council is Martin D. Young.

■ Association of Southeastern Biologists: pres., H. K. Wallace, University of Florida; past pres., George C. Kent, Louisiana State University; pres.-elect, M. E. Gaulden, Oak Ridge, Tenn.; v. pres., H. H. Hobbs, University of Virginia; sec., J. C. Dickinson, Jr., University of Florida; treas., A. W. Jones, University of Tennessee. Representative to the AAAS Council is M. E. Gaulden.

■ Southern Society for Philosophy and Psychology: pres., Richard H. Henneman, University of Virginia; sec., Wilse B. Webb, U.S. Naval School of Aviation Medicine, NAS, Pensacola, Fla. Representative to the AAAS Council is Richard H. Henneman.

■ American Society of Biological Chemists: pres., John T. Edsall; pres.-elect, Severo Ochoa; sec., Philip Handler; treas., Stanford Moore.

■ Pennsylvania Academy of Science: pres., Robert B. Gordon, State Teachers College, West Chester, Pa.; pres.-elect, Arthur W. Shively, Franklin and Marshall College; v. pres., Earl Bowen, Gettysburg College; v. pres., Bertil Anderson, Pennsylvania State University; sec., Kenneth Dearolf, Public Museum and Art Gallery, Reading, Pa. Representative to the AAAS Council is Kenneth Dearolf.

■ American Oil Chemists' Society: pres., H. C. Black; v. pres., J. C. Konen; sec., R. W. Bates, Armour and Company, Chicago, Ill.; treas., A. F. Kapecki.

■ Scientific Apparatus Makers Association: pres., Richard E. Welch, W. M. Welch Manufacturing Company, Chicago, Ill.; past pres., Henry F. Dever, Minneapolis-Honeywell Regulator Company; treas., T. M. Mints, E. H. Sargent and Company.

■ International Academy of Pathology: pres., William O. Russell, Texas; pres.-elect, Chapman Binford, Washington, D.C.; v. pres., Robert Stowell, Kansas City, Mo.; sec.-treas., F. K. Mostofi, Washington, D.C.

■ Cooper Ornithological Society: board of directors; pres., J. R. Pemberton; senior v. pres., W. J. Sheffler; junior v. pres., F. A. Pitelka; treas., J. C. von Bloeker, Jr.; sec., John Davis.

Forthcoming Events

June

23–29. **American Library Assoc., annual, Kansas City, Kans. (D. H. Clift, ALA Hq., 50 E. Huron St., Chicago 11, Ill.)**

23–30. **Rheumatic Diseases, 9th internatl. cong., in conjunction with American Rheumatism Assoc., Toronto, Ont., Canada. (E. Dunlop, Box 237, Terminal "A," Toronto.)**

24–26. Aging, 10th conf., Ann Arbor, Mich. (Div. of Gerontology, Univ. of Michigan, Rackham Bldg., Ann Arbor.)

24–26. American Soc. of Heating and Air-Conditioning Engineers, Murray Bay, Quebec, Canada. (A. V. Hutchinson, ASHAE, 62 Worth St., New York 13.)

24–27. Agricultural Inst. of Canada, with six other Canadian agricultural socs., annual, Vancouver, B.C. (W. J. Anderson, Dept. of Agricultural Economics, Univ. of British Columbia, Vancouver.)

24–28. American Inst. of Electrical Engineers, summer general, Montreal, Quebec, Canada. (N. S. Hibshman, AIEE, 33 W. 39 St., New York 18.)

24–28. Scientific Management, 11th internatl. cong., Paris, France. (Internatl. Committee of Scientific Management, 57, rue de Babylone, Paris 7e.)

24–29. Cosmical Gas Dynamics, 3rd symp. (by invitation), Internatl. Union of Theoretical and Applied Mechanics, Cambridge, Mass. (J. M. Burgers, Univ. of Maryland, College Park.)

25–27. Max Planck Soc. for the Advancement of Science, annual general assembly, Lübeck, Germany. (Max Planck Soc. for the Advancement of Science, Kaiserwertherstrasse 164, Dusseldorf, Germany.)

25–28. American Dairy Science Assoc., 51st annual, Stillwater, Okla. (H. F. Judkins, 32 Ridgeway Circle, White Plains, N.Y.)

25–28. American Home Economics Assoc., St. Louis, Mo. (Miss M. Horton, AHEA, 1600 20 St., NW, Washington 9.)

30–1. National Education Assoc., annual, Philadelphia, Pa. (W. G. Carr, NEA, 1201 16 St., NW, Washington 6.)

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July

1–3. Reproduction and Infertility, 3rd symp., Fort Collins, Colo. (F. X. Gassner, Colorado State Univ., Fort Collins.)

1–6. Brazilian Soc. for the Advancement of Science, 9th annual, Rio de Janeiro, Brazil. (Sociedade Brasileira Para o Progresso da Ciencia, Caixa Postal 2926, São Paulo, Brazil.)

1–6. Industrial Medicine, 12th internatl. cong., Helsinki, Finland. (L. Noro, Inst. of Occupational Health, Huapalahdenkatu 1, T8818, Helsinki.)

2–4. Neurological Basis of Behavior, Ciba Foundation Symp. (by invitation only), London, England. (G. E. W. Wolstenholme, Ciba Foundation, 41 Portland Pl., London, W.1.)

2–6. Physical Problems of Color Television, internatl. symp. of IUPAP, Paris, France. (Secretary, Colloque International sur les Problèmes de la Télévision en Couleurs, Conservatoire National des Arts et Métiers, 292, rue Saint-Martin, Paris 3e.)

3–6. Current Problems in Crystal Physics, conf. IUPAP and NSF, Cambridge, Mass. (J. S. Slater, Massachusetts Inst. of Technology, Cambridge 39.)

8–10. Astrophysical Symp., 8th internl., Liége, Belgium. (P. Swings, Institut d'Astrophysique, Université de Liége, Liége.)

8–10. Endocrine Aspect of Breast Cancer, Internatl. conf., Glasgow, Scotland. (A. P. M. Forrest, Dept. of Surgery, Western Infirmary, Glasgow, W.1.)

8–12. Inter-American Cong. of Philosophy, 5th, Washington, D.C. (R. M. Chisholm, Brown Univ., Providence, R.I.)

8–12. Poliomyelitis Conf., 4th internatl., Geneva, Switzerland. (Secretariat, 4th International Poliomyelitis Conference, Hotel du Rhone, Geneva.)

9–11. Biological Symp., 8th annual, Univ. of Michigan, Ann Arbor. (B. L. Baker, Dept. of Anatomy, Univ. of Michigan, Ann Arbor.)

9–13. European Molecular Spectroscopy Conf., Freiburg, Breisgau, Germany. (R. Mecke, Dept. of Physical Chemistry, Univ. of Freiburg, Freiburg.)

9–13. International Cong. for the Study of Social Insects, Paris, France. (G. Richard, International Union for the Study of Social Insects, Faculty of Sciences, University of Rennes, Rennes, France.)

10–12. Thermodynamic and Transport Properties of Fluids, conf., IUPAC, London, England. (Institution of Mechanical Engineers, 1, Birdcage Walk, Westminster, London, S.W. 1.)

10–17. International Union of Crystallography, 4th genl. assembly, Montreal, Canada. (G. A. Jeffrey, Chemistry Dept., Univ. of Pittsburgh, Pittsburgh 13, Pa.)

11–13. Applied Cytology, European Symp., Brussels, Belgium. (Secretary, Comm. on International Cong., American Cancer Soc., 521 W. 57 St., New York 19, N.Y.)

14–19. International Assoc. of Geron-

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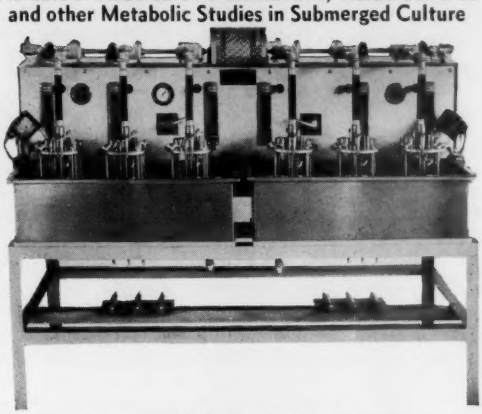

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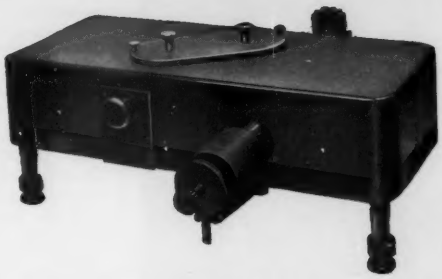

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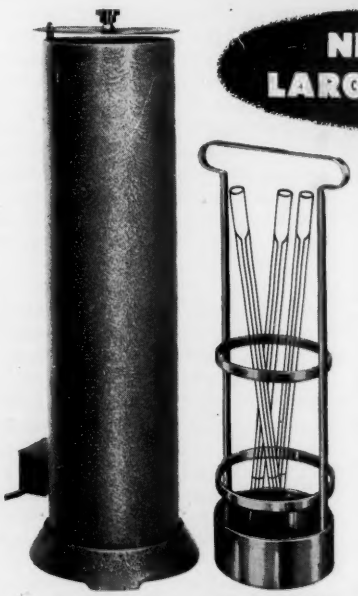

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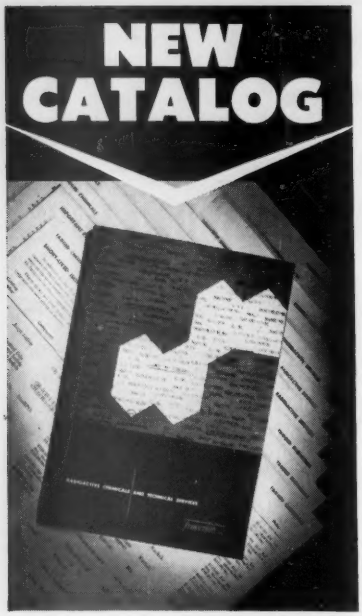

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14–20. Clinical Pathology, 4th internatl. cong., Brussels, Belgium. (M. Welsch, Service de Bacteriologie et de Parasitologie, Université de Liége, Blvd. de la Constitution, Liége, Belgium.)

15–18. Biochemistry of Lipids, International Colloquium, Oxford, England. (Dr. Sinclair, Laboratory of Human Nutrition, Oxford.)

15–19. Institute on College Administration, annual, Ann Arbor, Mich. (A. D. Henderson, 2442 U.E.S., Univ. of Michigan, Ann Arbor.)

16–19. American Malacological Union, annual, New Haven, Conn. (Miss M. C. Teskey, P.O. Box 238, Marinette, Wis.)

16–24. International Cong. for Pure and Applied Chemistry, 16th, Paris, France (R. Morf, Secy. Genl., IUPAC, Sandoz, S.A., Basel, Switzerland.)

20–21. Medical-Sociological Aspects of Senile Nervous Diseases, internatl. symp., Venice, Italy. (S. N. Feingold, Jewish Vocational Service of Greater Boston, 70 Franklin St., Boston 10, Mass.)

21–28. Neurological Sciences, 1st internatl. cong., Brussels, Belgium. (P. Bailey, National Institutes of Health, Bethesda 14, Md.)

23–24. Modern Electrochemical Methods of Analysis, Internatl. symp., Paris, France. (G. Charles, Ecole Superieure de Physique et de Chimie, 10, rue Vauquelin, Paris 5e.)

25–26. Structure Properties Relationships of Polymers (IUPAC), Paris, France. (International Union of Pure and Applied Chemistry, 4, Avenue de l'Observatoire, Paris 6e.)

25–29. Protein Chemistry Symp., IUPAC, Paris, France. (J. Roche, College de France, Place Marcellin Berthelot, Paris 5e.)

26–27. Experimental Psychology and Animal Behavior Section of International Union of Biology, Brussels, Belgium. (H. S. Langfeld, Dept. of Psychology, Princeton Univ., Princeton, N.J.)

26–27. Linguistic Soc. of America, Ann Arbor, Mich. (A. A. Hill, Box 7790, University Station, Austin 12, Tex.)

26–27. Military Psychology, internatl. symp., Brussels, Belgium. (National Academy of Sciences, 2101 Constitution Ave., NW, Washington 25.)

26–1. International Congress on Nutrition, 4th, Paris, France. (Quatrième Congrès International de Nutrition, CNERNA, 71, boulevard Péreire, Paris 17e.)

28–1. Psychoanalysis, 20th internatl. cong., Paris, France. (Dr. Nacht, 187, rue Saint-Jacques, Paris 5.)

28–3. Psychology, 15th internatl. cong., Brussels, Belgium. (L. Delys, 296, avenue des Sept Bonniers, Forest-Bruxelles.)

31–5. International Assoc. for Hydraulic Research, Lisbon, Portugal. (M. Coelho Mendes da Rocha, Laboratorio Nacional de Engenharia Civil, Avenida do Brasil, Lisbon.)

31–6. Dermatology, 11th internatl. cong., Stockholm, Sweden. (C. H. Floden, Hudkliniken, Karolinska Sjukhuset, Stockholm 60.)

(See issue of 17 May for comprehensive list)

EQUIPMENT NEWS

The information reported here is obtained from manufacturers and from other sources considered to be reliable. Science *does not assume responsibility for the accuracy of the information. All inquiries concerning items listed should be addressed to* Science, *Room 740, 11 W. 42 St., New York 36, N.Y. Include the name(s) of the manufacturer(s) and the department number(s).*

■ WAVEFORM GENERATOR, manufactured by Servomax Controls Ltd. for the low frequency range, provides 37 basic output waveforms, including sine, triangle, sawtooth, pulse, square, and trapezoid, as well as ramp and step functions. Dynamic frequency range is greater than 1 million to 1, with an absolute accuracy of ± 2 percent. Output may be continuously varied from 150 to 100 v peak-to-peak in six ranges. Sine waves may be generated at 500 to 0.0005 cy/sec. Pulse duration is variable from 1 m sec to 1000 sec with rise time, 10 to 90 percent of less than 5 μsec. (British Industries Corp., Dept. S327)

■ ROTATING-CYLINDER VISCOMETER is designed for making viscosity measurements at shear rates as low as 0.2 sec^{-1} without extrapolation. Electrostatic forces are used to supply restoring torque. (Polarad Electronics Corp., Dept. S323)

■ NUCLEAR-RADIATION SPECTROMETER consists of a linear pulse amplifier, a pulse-height analyzer, a ratemeter, and a high-voltage power supply. The pulse-height analyzer has a recovery time of 0.4 sec and covers the range of 1 to 100 v with 0.1-percent linearity and with a stability of better than 0.1 v for a 20-percent change in line voltage. An automatic scanner with scan times of ¼, ½, 1, 2, and 4 hours is included as an accessory. (Mt. Sopris Instrument Corp., Dept. S334)

■ CHROMATOGRAPH may be used for qualitative or quantitative separation of compounds with boiling points from 20° to 400°C. The sample is injected by a 0.25-ml syringe through a silicone-rubber gasket. Temperature may be increased 2°C per minute and maintained to ± 1°C. Interchangeable columns and a variety of column packings, as well as models with or without recorders, are available. (Wilkens Instrument and Research, Inc., Dept. S335)

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■ PRESSURE BALANCE is rated to 60,000 lb/in.^{2} with accuracy better than 1 in 10,000, sensitivity 1 in 100,000, and reproducibility 1 in 20,000. The balance includes a measuring cylinder and piston, a piston-rotating mechanism, and a weight-carrying system. Rotation of the piston above a critical speed reduces friction to less than 1 g. Ten different cylinders are used for the range to 60,000 lb/in.^{2} Pressure measurements are made with the piston rotated by its own inertia and the motive power disengaged. (Philips Electronics, Inc., Dept. S340)

■ CROSSBAR-SWITCH SCANNER is capable of scanning 200 points in sequence, one point per input pulse. The 200 points are arranged in 10 groups of 20 points each. Skipping of a group, return to the beginning, and stop at the end of a group can be accomplished by automatic command. Contact resistance is 0.02 ohm; thermoelectric potentials are less than 0.01 v in the range 25° to 50°C; leakage resistance is as much as 10^{12} ohm. (James Cunningham, Son and Co. Inc., Dept. S328)

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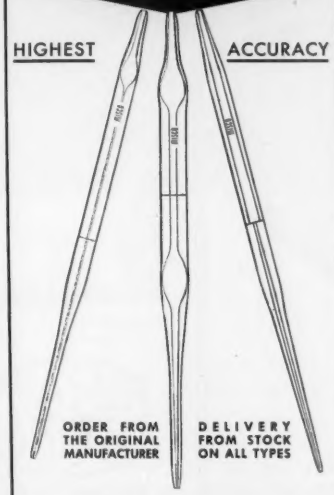

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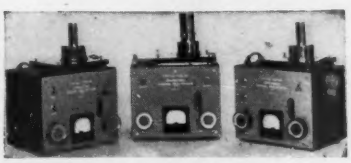

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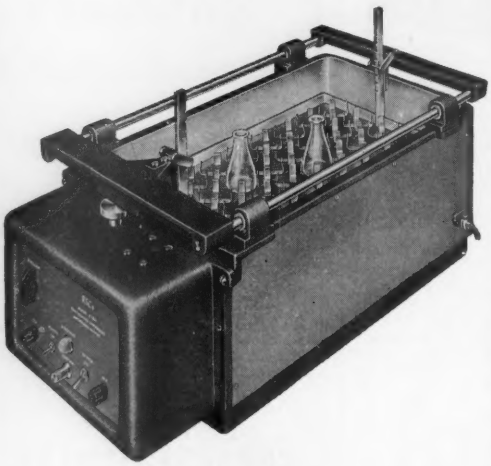

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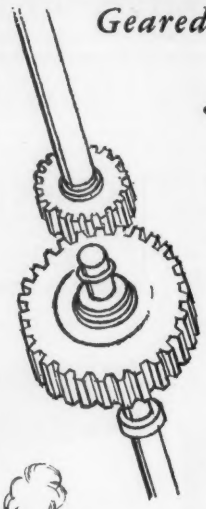

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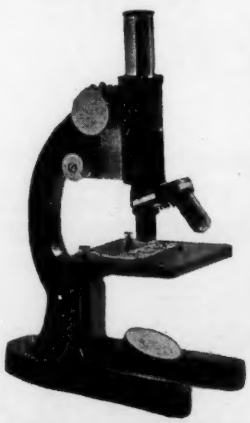

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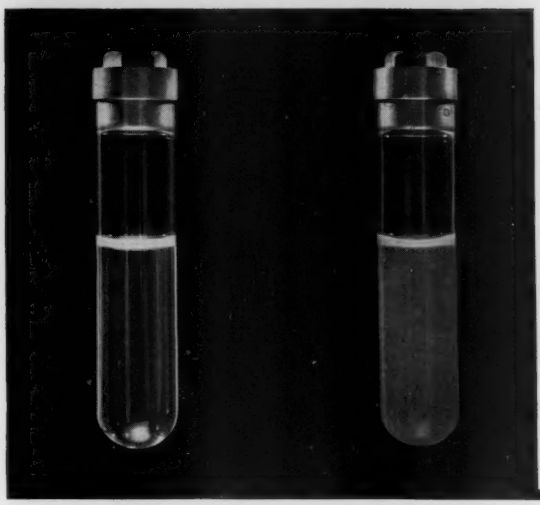

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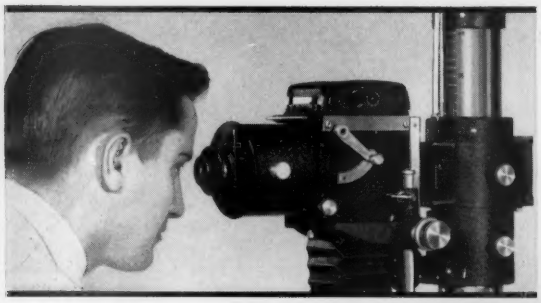

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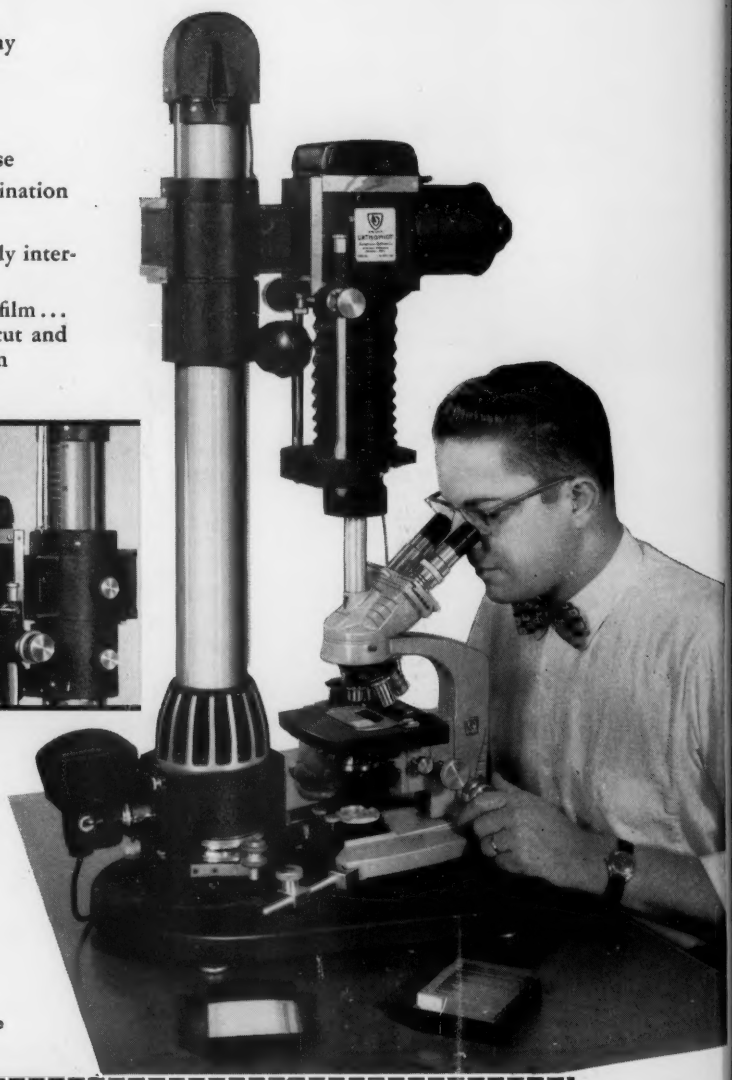

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